AL-14-000-3584

United States Senate

WASHINGTON, DC 20510

December 17, 2013

The Honorable Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington DC 20460

Re: Taxpayer Funds Expended on Reconsideration of Ozone NAAQS

Dear Administrator McCarthy:

We are writing to renew a longstanding, unanswered request for data related to federal funds and resources expended as part of EPA's unnecessary reconsideration of the national ambient air quality standard (NAAQS) for ground level ozone in the 2010-2011 timeframe. As you know, ozone attainment status significantly impacts state and local transportation planning, energy production and use, and economic development. EPA's reconsideration of the ozone standard in 2010-2011, years ahead of the regularly-scheduled review process established in the Clean Air Act (CAA), caused economic and regulatory uncertainty throughout the United States. Private businesses and organizations as well as federal, state, and local agencies incurred significant expenses analyzing EPA's proposal as well as participating in the public comment process. As the Assistant Administrator with responsibility for EPA's Office of Air & Radiation at the time, you led this ozone reconsideration effort and, as the Administrator, you are responsible for overseeing the current ozone review.

Many recognized EPA's reconsideration initiative as lengthy and unnecessary. For example, a recent report by the Congressional Research Service (CRS) suggests that the reconsideration was done as a political, rather than legal, matter and notes that the process took over a year and a half. Specifically, CRS explains:

> ***With the change of Administrations in 2009***, *EPA agreed to reconsider the 2008 [ozone] standard. As a result, a more stringent primary standard and a different version of the secondary standard were proposed in January 2010.* ***After a year and a half of public comment and review***, *EPA sent what it considered a final set of standards to OMB for interagency review. The process was short-circuited, however, by a Presidential decision to await conclusion of the next regular review—the review now nearing completion—before promulgating any change.*[1]

[1] CRS Report, Ozone Air Quality Standards: EPA's 2013 Revision (May 30, 2013) (emphasis added).

Moreover, as outlined in the recent Senate Environment and Public Works (EPW) Committee Minority Report entitled "Neglecting a Cornerstone Principle of the Clean Air Act: President Obama's EPA Leaves States Behind,"[2] many states commented about the adverse impacts of the ozone reconsideration proposal. For instance, the Ohio Environmental Protection Agency commented:

> *The timing of the proposal, i.e., reopening the standard just two years after it was set, is ill-considered and inconsistent with the schedule for review of NAAQS contained in the Clean Air Act... Attempting to implement a new standard while the previous standard is still being implemented has consistently caused strain, redundancy and inefficiency in the process and has led to seemingly endless rounds of litigation that takes the focus away from the important task at hand--real air quality improvements... U.S. EPA...should not add to the uncertainty and strain generated by the existing Clean Air Act obligations for attaining the ozone standard and generated by the five-year review of that NAAQS by prematurely reevaluating and reestablishing the ozone standard when neither law nor science requires it.*[3]

Similarly, the Missouri Department of Natural Resources commented:

> *[I]t cannot be overemphasized how much of an impact the reconsidered standard will have on limited resources at the state level... [T]he statewide public outreach effort required to provide information and notice to all affected areas will be unprecedented.*[4]

Other states commented as well, as discussed in the aforementioned EPW minority report. Additionally, a bipartisan coalition of concerned members of Congress urged EPA to forego the unnecessary reconsideration process.[5]

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[2] Senate Environment and Public Works Committee Minority Report, "Neglecting a Cornerstone Principle of the Clean Air Act: President Obama's EPA Leaves States Behind" (October 31, 2013).

[3] Comments of Ohio Envtl. Prot. Agency on EPA's Proposed 2010 Ozone Standards, Docket ID No. EPA-HQ-OAR-2005-0172-12376, at 3-4 (March 22, 2010).

[4] Comments of Mo. Dep't of Natural Res. on EPA's Proposed 2010 Ozone Standards, Docket ID No. EPA-HQ-OAR-2005-0172-12905, at 1-3 (March 16, 2010).

[5] Senate Environment and Public Works Committee Press Release, "Sessions Leads Bipartisan Effort Asking EPA To Not Change Its Air Quality Standard" (July 26, 2011); see also Letter from Sens. Voinovich, Bayh, Lugar, Landrieu, Vitter, McCaskill, and Bond to EPA (Aug. 6, 2010), available at http://www.insideindianabusiness.com/newsitem.asp?ID=43052.

Finally, even the President of the United States stepped in and recognized that this effort had to stop. In August 2011, when President Obama directed EPA to not proceed with the ozone reconsideration process, he explained that he "did not support asking state and local governments to begin implementing a new standard that will soon be reconsidered." In other words, following 18 months of an unnecessary federal regulatory process that was not mandated by the CAA, the President ordered EPA to stand-down.[6]

Soon after the President's decision, Senator Sessions wrote EPA in September 2011 inquiring about the "total costs incurred or expended by [EPA] ... on efforts related to reconsideration of the 2008 [ozone standard]." However, ever since that request, EPA has evaded providing a response. At your confirmation hearing, in April of this year, Senator Sessions asked you if you would respond to his questions for the record. You responded: "I absolutely will."[7] In those questions, you were specifically asked: "Did EPA incur significant costs as part of the ozone reconsideration process; if so, how much?" You wholly ignored the question in your response to the Committee, violating your pledge before the Committee. Again, in May of this year, EPA staff wrote Senate staff: "We haven't tracked down a response but are working on it." To date, no official EPA response has been provided. It has now been 26 months since the initial request.

We can only conclude, in the face of repeated refusals to respond to or acknowledge a legitimate question about how taxpayer money has been spent by EPA, that EPA either seeks to thwart our oversight role in this matter or cannot answer the question. Either explanation is deeply troubling. As Members of the Senate Committee with direct jurisdiction over EPA and the CAA, we have a responsibility to oversee Agency actions, including how it expends the resources made available to it by Congress. Our request is neither overly complex nor burdensome.

Again, we request that EPA provide to the Committee an accounting of EPA expenses incurred as part of its abandoned 2010-2011 ozone NAAQS reconsideration including the total costs incurred or expended by EPA from January 21, 2009 through August 31, 2011 on efforts related to the Agency's reconsideration of the 2008 NAAQS for ground level ozone. The estimate should account for EPA staff time (including salaries and benefits); expenses associated with the public hearings in Arlington, Virginia; Houston, Texas; Sacramento, California; as well as any other public hearings or meetings; third-party expenses for consultants, scientists, or other persons; and any other expense incurred by the Agency as part of this effort. In addition to the monetary costs of these efforts, please also provide the total man-hours expended by EPA staff on this effort during the stated timeframe.

[6] Office of Information and Regulatory Affairs, Letter from Cass Sunstein to Lisa Jackson (September 2, 2011).

[7] Senate Environment and Public Works Hearing, "Hearing on the Nomination of Gina McCarthy to be Administrator of the U.S. Environmental Protection Agency" (April 11, 2013).

We look forward to your prompt and thorough response by January 7, 2014.

Sincerely,

David Vitter
U.S. Senator

Jeff Sessions
U.S. Senator

James Inhofe
U.S. Senator

John Barrasso
U.S. Senator

Mike Crapo
U.S. Senator

Roger Wicker
U.S. Senator

John Boozman
U.S. Senator

Deb Fischer
U.S. Senator

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 15 2014

OFFICE OF
AIR AND RADIATION

The Honorable John Boozman
United States Senate
Washington, D.C. 20510

Dear Senator Boozman:

Thank you for your December 17, 2013, letter regarding the total costs incurred by the U.S. Environmental Protection Agency on efforts related to the reconsideration of the 2008 National Ambient Air Quality Standard (NAAQS) for ozone. The Office of Air and Radiation had primary responsibility for the ozone reconsideration, with staff from the Office of Research and Development and the Office of General Counsel also playing a role.

As you know, section 109(d) of the Clean Air Act requires the EPA to complete a review of the science upon which the NAAQS are based every five years. The standards for the six principal pollutants – carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, particulates, and ozone – are reviewed and revised on a rotating basis. EPA staff members who worked on the reconsideration of the 2008 standard are dedicated to understanding the science of public health problems from air pollution and advising the Administrator on how to set the standards. At any given time EPA staff may be working on some aspect of one or more of the NAAQS standards. The staff continually reviews health and environmental impacts of the pollutants identified in the Clean Air Act as NAAQS pollutants. During the reconsideration of the 2008 standard, the EPA also held public hearings with a wide variety of stakeholders in attendance.

The EPA is always learning more about how to set air pollution standards. The agency is using some of the work from the reconsideration effort to help inform NAAQS decisions moving forward. The agency is working on the next regular review of the ozone standard to determine what, if any, revisions to the ozone standards may be appropriate in light of the current scientific evidence. For these reasons, it is difficult for us to estimate, with any meaningful precision, the expenses and full-time equivalent employees used for the reconsideration of the 2008 standard specifically.

Again, thank you for your letter. If you have further questions, please contact me or your staff may contact Josh Lewis in the EPA's Office of Congressional and Intergovernmental Relations at lewis.josh@epa.gov or (202) 564-2095.

Sincerely,

Janet G. McCabe
Acting Assistant Administrator

AL-13-000-7698

United States Senate

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

WASHINGTON, DC 20510-6175

July 22, 2013

Ms. Nancy K. Stoner
Acting Assistant Administrator for the Office of Water
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW
Washington, D.C. 20460

Dear Acting Assistant Administrator Stoner:

We write to express our concern regarding the Environmental Protection Agency's (EPA) apparent attempt to deliberately inflate benefits calculations in order to justify the high cost of a rule. EPA is seeking to exaggerate benefits through the use of a "stated preference survey"[1] to calculate the alleged "non-use" benefits of the proposed rule for cooling water intake structures under Section 316(b) of the Clean Water Act (CWA).[2] Use of a stated preference survey is inappropriate. Furthermore, reliance on non-use benefits, as opposed to traditional "use" benefits, to justify a significant regulation is without precedent and should not be permitted. Accordingly, we request that EPA refrain from using this survey as a basis for the final rule and stick to well-established methods to determine the costs and benefits of the regulation.

In April 2011, EPA issued a proposed rule under Section 316(b) of the CWA, which requires that standards governing cooling water intake structures reflect the best technology available (BTA) for minimizing adverse environmental impact.[3] EPA's proposed rule would set new standards for cooling water intake structures at approximately 1,260 existing power generating and manufacturing and industrial facilities.[4] EPA is required by a modified court settlement agreement to publish the final rule by November 4, 2013.[5]

As part of its required regulatory analysis, EPA conducted an original cost-benefit analysis.[6] In this analysis, EPA used conventional methods to determine the use benefits for

[1] National Pollutant Discharge Elimination System--Proposed Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities; Notice of Data Availability Related to EPA's Stated Preference Survey, 77 Fed. Reg. 113 (proposed June 12, 2012) (to be codified at 40 C.F.R. pts. 122, 123, 124, 125).
[2] National Pollutant Discharge Elimination System—Cooling Water Intake Structures at Existing Facilities and Phase I Facilities, 76 Fed. Reg. 76 (proposed on April 20, 2011) (to be codified at 40 C.F.R. pts. 122 and 125).
[3] 33 U.S.C. § 1326(b).
[4] U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA 820-F-11-002, FACT SHEET: PROPOSED REGULATIONS TO ESTABLISH REQUIREMENTS FOR COOLING WATER INTAKE STRUCTURES AT EXISTING FACILITIES (2011), http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/upload/factsheet_proposed.pdf.
[5] Third Amendment to Settlement Agreement Among the Envtl. Prot. Agency, the Plaintiffs in Cronin v. Reilly, No. 93 Civ. 0314 (LTS) (S.D.N.Y.), and the Plaintiffs in Riverkeeper. v. EPA, No. 06 Civ. 12987 (PKC) (S.D.N.Y.) (June 27, 2013), *available at* http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/upload/amendment3rd.pdf.
[6] National Pollutant Discharge Elimination System—Cooling Water Intake Structures at Existing Facilities and Phase I Facilities, 76 Fed. Reg. 76 (proposed on April 20, 2011) (to be codified at 40 C.F.R. pts. 122 and 125).

commercial and recreational fishing.[7] EPA then decided that its first cost-benefit analysis was "incomplete" and attempted to recalculate not only the use benefits, but the non-use benefits as well.[8] In order to do so, EPA conducted a national "stated preference survey" in which individuals, who would gain no direct benefit, were asked how much they were hypothetically willing to pay to prevent distant fish from being harmed.[9] Attempting to monetize non-use benefits in this way, and on this scale, is highly questionable.

As you may know, stated preference surveys are one of the most controversial methods for estimating non-use benefits because they are based on what individuals say they would do as opposed to what they are actually observed doing.[10] There are very few instances in which such a complicated and subjective tool can be used with any degree of reliability.[11] According to leading economists, stated preference surveys should only be used in situations where the resources are unique or limited and the impacts are substantial or irreversible.[12] This is not the case here. The results of this survey cannot be taken as credible estimates of potential benefits of the proposed rule and certainly cannot be used to justify spending hundreds of millions or potentially billions of dollars each year. Accordingly, EPA should not use the results of the stated preference survey as a basis for the final rule.

Additionally, EPA conducted two separate benefits analyses in little more than a year that resulted in dramatically different conclusions.[13] EPA's original cost-benefit analysis, using conventional methods, determined that the $466 million annual costs of the preferred option outweighed the $16.3 million annual benefits by a ratio of 29 to 1.[14] Conversely, the annual benefits from the stated preference survey were $2.275 billion for the preferred option, with a cost to benefit ratio of 1 to 5.[15] This is a substantial and questionable increase in benefits, all due to EPA's decision to rely on a controversial method to recalculate benefits. If EPA were to substitute the survey results for the original benefits calculation, the majority of all benefits would be non-use benefits as opposed to the traditionally calculated use benefits associated with commercial and recreational fishing. This would be highly unusual. EPA has never attempted to justify an entire regulation primarily on non-use benefits. Doing so now would set a dangerous precedent that would interject arbitrariness and unpredictability in the regulatory process and allow regulators to justify actions based on public opinion surveys rather than sound science.

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[7] *Id.*
[8] National Pollutant Discharge Elimination System--Proposed Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities; Notice of Data Availability Related to EPA's Stated Preference Survey, 77 Fed. Reg. 113 (proposed June 12, 2012) (to be codified at 40 C.F.R. pts. 122, 123, 124, 125).
[9] *Id.*
[10] *See* Jerry Hausman, *Contingent Valuation: From Dubious to Hopeless*, 26(4) J. ECON. PERSPECTIVES 43 (2012).
[11] *Id.*
[12] A. MYRICK FREEMAN, THE MEASUREMENT OF ENVIRONMENTAL AND RESOURCE VALUES: THEORY AND METHODS 156-57 (Resources for the Future 2003) (1993).
[13] Comments on EPA's notice of Data Availability for §316(b) Stated Preference Survey: Prepared for: Utility Water Act Group and Edison Electric Institute, NERA ECON. CONSULTING E-8 (July 2012), http://www.nera.com/nera-files/PUB_UWAG_0712_final.pdf.
[14] *Id.*
[15] *Id.*

EPA's previous estimate of use benefits associated with commercial and recreational fishing provides a far more accurate gauge of the potential benefits of the proposed rule than the results of the controversial stated preference survey. Accordingly, EPA should withdraw the survey and not attempt to use the results as a basis for the final rule.

If you have any questions regarding this letter, please feel free to have your staff contact Kristina Moore with the Senate Committee on Environment and Public Works at (202) 224-6176.

Sincerely,

David Vitter
U.S. Senator

James Inhofe
U.S. Senator

Mike Crapo
U.S. Senator

John Boozman
U.S. Senator

cc: Ken Kopocis
Senior Advisor for the Office of Water

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 16 2014

OFFICE OF WATER

The Honorable John Boozman
United States Senate
Washington D.C. 20510

Dear Senator Boozman:

Thank you for your letter of July 22, 2013, regarding the use of the stated preference survey to calculate benefits for the Clean Water Act section 316(b) cooling water intake structures rule. I appreciate you sharing your concerns regarding the stated preference survey approaches the agency outlined in its June 12, 2012, Notice of Data Availability.

Section 316(b) requires that cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. The environmental impact of greatest concern under section 316(b) is the protection of fish and other aquatic organisms. The vast majority of these organisms – well over 90 percent – are not fish that would be caught commercially or recreationally. Nonetheless, these organisms are a critical part of the food chain, and as such, clearly have value. There is value in the existence of fully functional ecosystems and such values, which are not associated with human uses like fishing, and fish marketing and consumption, are called nonuse values.

The agency is obligated to perform a benefit-cost analysis under Executive Orders 12866 and 13563 using "the best available techniques." To obtain a more accurate assessment of benefits than could be ascertained through an assessment of only use values, the EPA determined it was necessary to estimate nonuse values. Because stated preference surveys are necessary to estimate these nonuse values, the EPA used the stated preference technique for this purpose.

Stated preference surveys are a well-established approach for conducting economic analyses associated with government actions. The EPA has used stated preference results as a basis for estimating benefits associated with the agency's actions in many instances. For example, the EPA uses stated preference to value improvements to health and the environment, including reduced mortality risk, chronic bronchitis, exacerbated asthma, non-fatal cancer, and visibility. Other agencies, such as the Department of Health and Human Services, the Department of the Interior, the National Oceanic and Atmospheric Administration, and the U.S. Census Bureau, all use stated preference methods.

The EPA's Peer Review Handbook concludes that all stated preference surveys should be subject to an external peer review, and the EPA conducted such a peer review on the stated preference survey. We are still working on responding to the constructive comments we received during that review and also decided to have the Science Advisory Board review the stated preference survey and analysis. The SAB review could take a full year or more to complete. The EPA's previously expressed reluctance (in a

Notice of Data Availability, 77 FR 34927, June 12, 2012) to release estimates that had not been fully reviewed extends to the SAB review as well. Therefore, the EPA does not plan to use the stated preference survey results as a basis for the final CWA Section 316(b) rule.

Again, thank you for your letter. If you have further questions, please contact me or your staff may call Greg Spraul in the EPA's Office of Congressional and Intergovernmental Relations at spraul.greg@epa.gov or (202) 564-0255.

Sincerely,

Nancy K. Stoner
Acting Assistant Administrator

AL-14-000-1791

United States Senate

WASHINGTON, DC 20510

November 13, 2013

The Honorable Gina McCarthy
Administrator, U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington DC 20460

Dear Administrator McCarthy:

We are writing to express our views regarding the Environmental Protection Agency's (EPA) upcoming Maximum Achievable Control Technology (MACT) rule for brick and structural clay processes, which is scheduled for proposal by February 6, 2014, and finalization by December 18, 2014.[1] This "Brick MACT," if crafted imprudently, could jeopardize the economic viability of brick manufacturers and distributors in our states and imperil hundreds of thousands of jobs nationwide. We urge you to exercise the discretion provided by Congress in the Clean Air Act (CAA) to minimize regulatory burdens on the brick industry that do not provide commensurate environmental benefit. We urge EPA to fully consider how such measures would affect public health and the economic vitality of brick manufacturers, distributors, and communities that rely on them for their livelihood.

The brick industry is in a unique situation. In 2003, EPA issued a Brick MACT (68 Fed. Reg. 26,689) that the brick industry implemented at a total compliance cost of approximately $100 million. Controls installed to comply with the 2003 MACT rule largely remain in operation. This 2003 MACT, however, was subsequently vacated by a federal court in 2007 due to no fault of the brick industry. As you can appreciate, it is highly problematic when an industry is subject to two consecutive rounds of technology-based MACT rules, particularly after compliance was attained with the first technology-based MACT. Moreover, we are concerned that the lower emission levels attained from controls installed to comply with the 2003 vacated rule may be used as the baseline for the second MACT and may result in an even more stringent rule than would have been imposed absent the first MACT. This "MACT on MACT" situation could require the costly removal and replacement of still-viable air pollution control devices without producing actual environmental or human health benefits.

On December 7, 2012, EPA published a proposed schedule for a new Brick MACT pursuant to efforts to negotiate a consent decree with the complainant in the case vacating the 2003 Brick MACT. We appreciate that EPA has amended this proposed consent decree to add an additional six months to the schedule for the proposed rule. This newly proposed schedule envisions a final rule issuance late December of 2014. We urge EPA to continue to review the schedule and identify if and when additional changes to the final schedule should be made.

[1] This letter is being sent in coordination with a bipartisan group comprised of 53 members of the U.S. House of Representatives who wrote you with these same concerns in a letter dated November 6, 2013.

We respectfully request that EPA use this time to take the steps necessary to promulgate a rule that protects public health and the environment, but does not impose unwarranted burdens on the brick industry. We believe such an approach would include the following:

1. **Consideration of Work Practice Standards and Accurate Regulatory Burden Estimates.** We urge EPA to use its authority in the CAA to consider work practice standards, wherever reasonable, including for the relatively small amount of metal HAP emissions, including mercury. This review should include an assessment of whether work practice standards are warranted for all pollutants not covered by a health-based standard. EPA is currently considering very expensive controls for the minimal amounts of mercury that the brick industry emits. The brick industry is on the list for MACT development because of acid gasses, not metal emissions, and to absorb crippling control costs to receive minor reductions in the amount of mercury and metals the industry emits may not be justified or even required to meet the requirements of the Clean Air Act. In addition, since EPA's estimated annual compliance costs are significant (running well over $150,000,000 per year) and the rule will impact a substantial number of small businesses, thoughtful consideration of the additional reviews required to comply with the Regulatory Flexibility Act (RFA) are critical. EPA must develop a thorough Initial Regulatory Flexibility Analysis that assesses the impacts on small businesses and examines less burdensome alternatives. EPA must also provide accurate estimates of the costs of the rule and a reasonable determination of the technical feasibility of control devices to meet the standard as an essential part of an initial RFA. We believe work practice standards could both protect the environment and eliminate unwarranted burdens.

2. **Health-based standard.** CAA Section 112(d)(4) allows for consideration of health-based thresholds when establishing MACT standards for a category. While this action is discretionary under the CAA, the unique MACT on MACT situation discussed above, as well as the limited quantity of emissions generated by brick manufactures justify full consideration of the health-based approach for standards set pursuant to this rule. If EPA chooses not to pursue a health-based approach to this regulation, we ask that EPA explain fully why this approach is not reasonable for this industry.

3. **Establish reasonable subcategories.** The CAA provides ample authority for EPA to use its discretion to establish subcategories when evaluating MACT for an industry. We urge EPA to use this discretion to minimize unnecessary "MACT on MACT" impacts for this industry, including the removal of viable air pollution control devices installed in good faith to comply with the 2003 MACT. At a minimum, EPA should maintain the same subcategories as in the 2003 rule. However, EPA should fully explore all potential subcategorization options.

Thank you for considering the incorporation of these environmentally-responsible and cost-conscious approaches as EPA develops the proposed Brick MACT rule. A reasonable standard will ensure that human health and the environment are protected and that this essential industry can continue to thrive, generate jobs in our states, and help our struggling economy rebound.

Sincerely,

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 13 2014

OFFICE OF
AIR AND RADIATION

The Honorable John Boozman
United States Senate
Washington, DC 20510

Dear Senator Boozman:

Thank you for your letter of November 13, 2013, co-signed by 17 of your colleagues, to U.S. Environmental Protection Agency Administrator Gina McCarthy, regarding standards that the EPA is in the process of developing for the brick industry. The Administrator has asked that I respond on her behalf.

The EPA is required to set national emissions standards for hazardous air pollutants (NESHAP) under section 112(d) of the Clean Air Act (CAA). As you mention in your letter, although the EPA issued a NESHAP for this industry in 2003, the United States Court of Appeals for the District of Columbia Circuit vacated that rule in 2007. We are in the process of developing a new rule in response to the vacatur. The brick and structural clay manufacturing industry remains unregulated under CAA section 112(d) because no federal 112(d) standard is in place. Sources in this industry emit a number of air toxics, including hydrogen fluoride, hydrogen chloride and toxic metals (such as antimony, arsenic, beryllium, cadmium, chromium, cobalt, mercury, manganese, nickel, lead and selenium).

Your letter asks that the EPA consider work practice standards, wherever reasonable, and that we assess the cost impacts that the proposed standards will have on the brick industry. We agree that in some cases work practices may be appropriate, and we are assessing the potential use of work practice standards where it is reasonable and consistent with the requirements of the CAA. The EPA analyzes the costs that may be associated with all proposed rules and will conduct a regulatory impact analysis (RIA) to thoroughly assess the impacts.

You ask that we consider health-based standards and that we use our discretion to establish subcategories. We are aware of the brick industry's desire that we set health-based standards and we will consider them as we develop the proposed rule. We also agree that subcategorization is an important consideration and we are evaluating all potential subcategories that may be appropriate for the brick industry.

In closing, I would like to underscore that we are sensitive to the impact that this rulemaking may have on the brick industry. As we go forward, we are considering a variety of options based on the diversity of process units, operational characteristics and other factors affecting hazardous air pollutant emissions. I can assure you that we will consider the concerns of the brick industry as we develop the proposed rule.

Again, thank you for your letter. If you have further questions, please contact me or your staff may contact Kevin Bailey in the EPA's Office of Congressional and Intergovernmental Relations at bailey.kevin@epa.gov or (202) 564-2998.

Sincerely,

Janet G. McCabe
Acting Assistant Administrator

AL-14-000-0896

United States Senate

WASHINGTON, DC 20510

October 31, 2013

The Honorable Gina McCarthy
Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Administrator McCarthy,

We are contacting you regarding our concerns about the EPA's announced listening tour on developing new carbon limit regulations for existing coal fired power plants.

The EPA recently began a listening tour which will visit eleven cities across the country to hear the public's views on placing carbon limits on existing coal fired power plants. All but one of these cities is a major metropolitan area (New York, Boston, Washington D.C., Philadelphia, Atlanta, Chicago, Dallas, Denver, San Francisco, and Seattle). The exception is Lenexa in Kansas, which is actually located in the Kansas City, Kansas metropolitan area.

Most of these areas are not where coal is either utilized or produced in any significant way. Your listening tour will miss seventeen of the top twenty coal burning states. In addition, your tour will miss sixteen of the top twenty coal producing states, including the top three (Wyoming, West Virginia and Kentucky).

As your regulations will likely have a significant negative impact on the use and development of coal, and the livelihoods and energy bills for folks across rural America, it only makes sense that you should actually go to the areas that will be most impacted by your policies. Unfortunately, it appears your listening tour will merely rubber stamp whatever pre-conceived policy this Administration was planning on pursuing in the first place.

We respectfully request that you consider hearing the opinions of the people most impacted by your policies. Americans most impacted by your policies deserve to be heard.

Sincerely,

John Barrasso David Vitter

Michael B. Enzi

Mike Johanns Pat Toomey

Mike Crapo Deb Fischer

John Boozman Jim E. Risch

Orrin Hatch

JAN 15 2014

OFFICE OF
AIR AND RADIATION

The Honorable John Boozman
United States Senate
Washington, D.C. 20510

Dear Senator Boozman:

Thank you for your letter of October 31, 2013, to U.S. Environmental Protection Agency Administrator Gina McCarthy, co-signed by ten of your colleagues, requesting that the EPA hold listening sessions in your states on reducing carbon pollution from existing power plants. The Administrator has asked that I respond on her behalf.

The EPA is working diligently to address carbon pollution from power plants. In June 2013, President Obama called on agencies across the federal government, including the EPA, to take action to cut carbon pollution to protect our country from the impacts of climate change, and to lead the world in this effort. His call included a directive for the EPA "to work expeditiously to complete carbon pollution standards for both new and existing power plants." Currently, there are no federal standards in place to reduce carbon pollution from the country's largest source. The President also directed the EPA to work with states, as they will play a central role in establishing and implementing standards for existing power plants, and, at the same time, with leaders in the power sector, labor leaders, non-governmental organizations, other experts, tribal officials, other stakeholders, and members of the public, on issues informing the design of carbon pollution standards for power plants.

As we consider guidelines for existing power plants, the EPA is engaged in vigorous and unprecedented outreach with the public, key stakeholders, and the states. The eleven listening sessions the EPA held throughout the country were attended by thousands of people, representing many states and a broad range of stakeholders, including many from the coal industry. In addition, the EPA leadership and senior staff, in Washington, D.C. and in every one of our ten regional offices, have been meeting with industry leaders and CEOs from the coal, oil, and natural gas sectors; state, tribal, and local government officials from every region of the country, including your state; and environmental and public health groups, faith groups, labor groups, and others. Our meetings with state governments have encompassed leadership and staff from state environment departments, state energy departments and state public utility commissions. We are doing this because we want—and need—all available information about what is important to each state and stakeholder. We know that guidelines require flexibility and sensitivity to state and regional differences.

To this end, we welcome feedback and ideas from you as well as your constituents about how the EPA should develop and implement carbon pollution guidelines for existing power plants under the Clean Air Act. Interested stakeholders can send their thoughts through email at carbonpollutioninput@epa.gov. Stakeholders can also learn more about what we are doing at www.epa.gov/carbonpollutionstandard. I welcome you to provide a link to our website from yours, and to share any other information about the EPA's public engagement activities with the citizens of your state.

Please note that the public meetings we've been holding to date and other outreach efforts are happening well before we propose guidelines. When we issue the draft guidelines in June 2014, a more formal public comment period will follow, as with all rules, and more opportunities for public hearings and stakeholder outreach and engagement. I look forward to hearing what you think about the draft guidelines at that time, too.

Again, thank you for your letter. If you have further questions, please contact me or your staff may contact Kevin Bailey in the EPA's Office of Congressional and Intergovernmental Relations at (202) 564-2998 or bailey.kevin@epa.gov.

Sincerely,

Janet G. McCabe

Janet G. McCabe
Acting Assistant Administrator

AL-14-001-1615

United States Senate

WASHINGTON, DC 20510

June 26, 2014

Ms. Nancy K. Stoner
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave, NW
Washington, DC 20460

Dear Acting Assistant Administrator Stoner:

As you are aware, the Environmental Protection Agency (EPA) has imposed costly stormwater regulations upon American military bases, despite objections from the Department of Defense (DOD).[1] At the same time, EPA is currently attempting to expand its Clean Water Act (CWA) authority over countless public and private landowners. We are concerned that these actions represent a larger effort to control land use decisions made by the military, homeowners, small businesses, and municipalities. We request your input in order to more fully understand EPA's CWA agenda and its implications for landowners throughout the country.

This inquiry is in response to recent EPA permitting decisions which have restricted post-construction stormwater discharges at Buckley Air Force Base in Colorado and Joint Base Lewis-McChord in Washington.[2] At each base, EPA attempted to force the military to limit the flow of stormwater on impervious surfaces, despite lacking authority to do so under the CWA. DOD challenged EPA's restrictions in administrative appeals, no doubt recognizing that regulating stormwater flow into each base's municipal separate storm sewer system (MS4) would add significant costs to base construction projects and tie up the military with unnecessary red tape.

Although we understand these individual cases may soon be settled, we wish to express our strong opposition to EPA's regulation of newly developed and redeveloped property at military bases as well as the agency's stormwater agenda at-large. Members of Congress have repeatedly reminded EPA of the statutory limits placed on the agency's authority to regulate stormwater flow apart from pollutant discharges. As Members of the Senate Environment and Public Works Committee have previously warned, if EPA wishes to establish new stormwater discharge regulations—including discharge standards for developed and redeveloped property at military bases and elsewhere—it must first report to Congress on the necessity of such

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[1] *See* Petition for Review of NPDES Permit for Buckley Air Force Base Municipal Separate Storm Sewer System (MS4), *In re: Buckley Air Force Base MS4*, NPDES Appeal No. 13-07, (U.S.E.P.A. Envtl. Appeals Bd., Sept. 30, 2013) (discussing DOD objections and comments regarding EPA permit).
[2] *See* David LaRoss, *EPA, DOD Settle Appeal of Stormwater Retention Permits, Averting Ruling*, INSIDEEPA.COM (May 2, 2014), http://insideepa.com/201405022469599/EPA-Daily-News/Daily-News/epa-dod-settle-appeal-of-stormwater-retention-permits-averting-ruling/menu-id-95.html.

regulations.[3] Until such time, EPA may not impose stormwater restrictions upon newly developed and redeveloped property, whether directly on sites otherwise exempted from permitting under CWA Section 402(p)(1), or indirectly through the MS4 permitting program. Moreover, EPA has no authority under the stormwater or other CWA programs to regulate the mere flow of water on public and private property.[4]

Unfortunately, EPA appears intent on ignoring the CWA's statutory limits and transparency requirements for new stormwater discharge regulations. In its May 5, 2014 letter to Senator Vitter, EPA indicated it would "continue to leverage existing requirements to strengthen municipal stormwater permits and continue to promote green infrastructure as an integral part of stormwater management."[5] EPA's statement is troubling for three reasons.

First, EPA's statement suggests the agency has no immediate plans to provide Congress with a report identifying the need for new stormwater discharge regulations or the basis for an expansion of the CWA permitting program to otherwise unregulated sites. Second, the agency's claim that it will continue its "stormwater management" effort belies the fact that the CWA does not provide the agency with authority to manage or otherwise regulate stormwater *per se*.[6] Third, EPA's threat of "leveraging" existing requirements (as it exemplified in the recent permitting restrictions at Buckley Air Force Base and Joint Base Lewis-McChord) leads us to believe that EPA intends to expand its permitting authority to regulate nonpoint source stormwater flow through an indirect permit-by-permit approach that contravenes the agency's CWA authority.

We emphasize that although EPA's intrusion into the military's land management is quite troubling, our concerns are not limited to the stormwater context. Rather, we view EPA's stormwater agenda as contributing to the agency's ill-advised, larger quest to dictate the land use decisions of public and private entities throughout the country. We note in particular EPA's proposed "waters of the United States" rule, which would federalize innumerable local streams, ditches, ponds, and drainage systems.[7]

Indeed, the proposed rule represents the agency's latest land grab and the most serious threat to Americans' property rights. The proposal's sweeping coverage to virtually any wet area would subject countless private and public lands to EPA's permitting requirements. Notably, whereas the military may have the resources and wherewithal to challenge the unfounded EPA stormwater regulations discussed above, we doubt homeowners, small businesses, farmers, and

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[3] *See* Letter from Senator David Vitter, et al., to Nancy K. Stoner, Acting Assistant Administrator, Environmental Protection Agency Office of Water (May 30, 2013) (attached).

[4] In addition, Section 438 of the Energy Independence and Security Act (EISA) does not change or expand EPA's CWA authority, nor does it sanction the CWA's National Pollutant Discharge Elimination System (NPDES) as a means to achieve EISA standards. *See* 42 U.S.C. § 17094.

[5] *See* Letter from Nancy K. Stoner, Acting Assistant Administrator, Environmental Protection Agency Office of Water, to Senator David Vitter (May 5, 2014) (Stoner Letter) (attached).

[6] *See id.*

[7] *See* Proposed Definition of "Waters of the United States" Under the Clean Water Act, 79 Fed. Reg. 22188 (April 21, 2014).

municipalities will be as able to defend themselves against costly permitting requirements and endless litigation resulting from the "waters of the United States" rule.

EPA's CWA regulations pose significant consequences for the military and the nation's economic well-being. At a minimum, EPA must be transparent with regard to any effort to impose further stormwater restrictions upon military bases or land use restrictions upon other land owners. Accordingly, we ask that EPA provide responses to the following inquiries no later than August 15, 2014:

1) Provide any and all documents, including (but not limited to) correspondence, memoranda, analyses, directives, and emails regarding how the agency will "provide incentives, technical assistance, and tools to communities to encourage them to implement strong stormwater programs,"[8] as well as how EPA will "leverage existing requirements to strengthen municipal stormwater permits"[9] and/or "promote green infrastructure as an integral part of stormwater management."[10]

2) Provide a list of all military municipal separate storm sewer systems (MS4's) and all non-military MS4's in which EPA has sought or will seek to establish, impose, or otherwise enforce stormwater control measures for new and re-developed impervious surfaces, including measures which would restrict the flow of water on impervious surfaces.

3) Provide any and all documents, including (but not limited to) correspondence, memoranda, analyses, directives, emails, and other documents relating to the EPA's position on *Va. Dep't of Transpt. v. U.S. EPA*, 2013 U.S. Dist. LEXIS 981 (E.D.Va. Jan. 3, 2013) (*VDOT*), *VDOT*'s applicability to the CWA's National Pollutant Discharge Elimination System (NPDES) and other CWA programs, and the EPA's authority (or lack thereof) under the CWA to regulate the mere flow of water.

4) In *Solid Waste Agency of Cook County v. Army Corps of Engineers*, 531 U.S. 159 (2001) (*SWANCC*), the Supreme Court invalidated the Army Corps' CWA regulation of an isolated, nonnavigable pond. Is it EPA's position that the proposed rule would provide a basis for the EPA and Army to reassert CWA jurisdiction over the waterbody that was determined to be nonjurisdictional in *SWANCC*?

Sincerely,

David Vitter
Ranking Member
Environment & Public Works Committee

Jim Inhofe
Ranking Member
Armed Services Committee

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[8] Stoner Letter *supra* note 5.
[9] *Id.*
[10] *Id.*

John Barrasso
U.S. Senator

Mike Crapo
U.S. Senator

Roger Wicker
U.S. Senator

John Boozman
U.S. Senator

Deb Fischer
U.S. Senator

cc: Gina McCarthy
Administrator, U.S. Environmental Protection Agency

John Conger
Acting Deputy Under Secretary Of Defense (Installations and Environment)
U.S. Department of Defense

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

MAY - 5 2014

OFFICE OF WATER

The Honorable David Vitter
Ranking Member
Committee on Environment and Public Works
United States Senate
Washington, D.C. 20510

Dear Senator Vitter:

Thank you for your May 20, 2013, letter regarding the U.S. Environmental Protection Agency's effort to strengthen its stormwater program. We appreciate your interest in this important issue.

As we engaged stormwater program stakeholders, we learned that many developers were already incorporating sustainable controls into sites, and states and communities were implementing programs that would meet or exceed any requirements we were considering. In light of this, the agency has decided to update its stormwater strategy to focus now on pursuing a suite of immediate actions to help support communities in addressing their stormwater challenges. As part of this effort, the agency is deferring action on stormwater rulemaking and will instead provide incentives, technical assistance, and tools to communities to encourage them to implement strong stormwater programs. The EPA will continue to leverage existing requirements to strengthen municipal stormwater permits and continue to promote green infrastructure as an integral part of stormwater management. This approach will achieve significant, measurable, and timely results in reducing stormwater pollution and provide significant climate resiliency benefits to communities.

Thank you again for your interest in our stormwater program and for your letter. If you have further questions, please contact me or your staff may contact Greg Spraul in the EPA's Office of Congressional and Intergovernmental Relations at spraul.greg@epa.gov or 202-564-0255.

Sincerely,

Nancy K. Stoner
Acting Assistant Administrator

United States Senate

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

WASHINGTON, DC 20510-6175

May 20, 2013

The Honorable Nancy K. Stoner
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave, NW
Washington, D.C. 20460

Dear Acting Assistant Administrator Stoner:

It is our understanding that the Environmental Protection Agency (EPA) is drafting a rule that would require individuals and small businesses to comply with costly new regulations limiting stormwater flow from developed or redeveloped property. We are concerned that EPA is developing this National Stormwater Rule in a manner that is clearly inconsistent with the Clean Water Act. In addition, EPA has failed to provide small businesses a meaningful opportunity to participate in the rulemaking, in conflict with the agency's stated obligations under the Small Business Regulatory Enforcement Fairness Act (SBREFA).

These errors strongly suggest that EPA has engaged in a rushed and uninformed rulemaking, in contrast to the deliberative process Congress intended. Having neglected to work with Congress and the small business community, EPA runs the risk of promulgating a rule practical only in the minds of agency personnel. We therefore request that EPA suspend its rulemaking for the National Stormwater Rule until the agency complies with its obligations under the Clean Water Act and SBREFA.

As you have previously acknowledged, EPA's authority for promulgating new stormwater discharge regulations derives from Section 402(p)(6) of the Clean Water Act.[1] Section 402(p)(6) requires that such regulations be "based on the results of . . . studies conducted under" Section 402(p)(5).[2] In turn, Section 402(p)(5) mandates EPA to prepare stormwater discharge studies "in consultation with the States" and to report on the results of the studies to Congress.[3] The report must inform Congress of potential "procedures and methods to control stormwater discharges to the extent necessary to mitigate impacts on water quality."[4] After completing a stormwater discharge study and providing a corresponding report to Congress, EPA may then proceed to conduct a rulemaking for new stormwater discharge regulations.[5]

To date, however, EPA has not provided Congress with a report on the necessity of new stormwater discharge regulations, nor has it indicated how the agency is consulting with the

[1] Letter from Nancy K. Stoner, Acting Assistant Administrator, Environmental Protection Agency Office of Water, to Senator James M. Inhofe (Sept. 30, 2011) ("Stoner Letter") (attached).
[2] 33 U.S.C. § 1342(p)(6).
[3] *Id.* § 1342(p)(5).
[4] *Id.* § 1342(p)(5)(c).
[5] *Id.* § 1342(p)(6).

States in preparing a Section 402(p)(5) study. Although you informed Senator Inhofe in 2011 that EPA "plans to submit [a] report to Congress before proposing to regulate any additional stormwater discharges under Clean Water Act Section 402(p)(6)," EPA has yet to fulfill this promise.[6] The agency's failure to report on the necessity of new stormwater discharge regulations is especially troubling given the agency's stated intention to propose its National Stormwater Rule no later than June 10, 2013.[7]

At the same time, EPA has disregarded SBREFA's purpose to "encourage the effective participation of small businesses in the regulatory process."[8] Notably, EPA's guidance on SBREFA recognizes that "Congress intended agencies to provide small entities with a meaningful opportunity to participate in the rules that may significantly affect them," and that "sufficient information" should be distributed to small business representatives so that they can provide appropriate input during a rulemaking.[9] Yet we understand that little information was provided to small business representatives during the SBREFA review for the National Stormwater Rule, thereby preventing businesses from offering meaningful input on the potential impact of the Rule.

EPA should not develop rules and regulations in haste, and the deliberative processes required under the Clean Water Act and SBREFA bind the agency to this principle. Prior to issuing its National Stormwater Rule, EPA must report to Congress on the necessity of new stormwater discharge regulations and seek meaningful input from the small business community. Accordingly, we ask that the agency suspend rulemaking for the National Stormwater Rule until EPA has satisfied these requirements.

If you have questions regarding this request, please feel free to have your staff contact Brandon Middleton with the Senate Committee on Environment and Public Works at (202) 224-6176.

Sincerely,

David Vitter
U.S. Senator

James Inhofe
U.S. Senator

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[6] *See* Stoner Letter.
[7] *See* Environmental Protection Agency, *Proposed National Rulemaking to Strengthen the Stormwater Program*, http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm (last visited May 17, 2013).
[8] Small Business Regulatory Enforcement Fairness Act of 1996, Pub. L. No. 104-121, 110 Stat. 847.
[9] Environmental Protection Agency, *Final Guidance for EPA Rulewriters: Regulatory Flexbility Act as amended by the Small Business Regulatory Enforcement Fairness Act* at 49 (Nov. 2006), http://www.epa.gov/rfa/documents/Guidance-RegFlexAct.pdf.

John Barrasso
U.S. Senator

Jeff Sessions
U.S. Senator

Mike Crapo
U.S. Senator

Roger Wicker
U.S. Senator

John Boozman
U.S. Senator

Deb Fischer
U.S. Senator

cc: The Honorable Bob Perciasepe
Acting Administrator
U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 2 9 2014

OFFICE OF WATER

The Honorable John Boozman
United States Senate
Washington, D.C. 20510

Dear Senator Boozman:

Thank you for your June 26, 2014, letter to the U.S. Environmental Protection Agency expressing your concerns about implementation of the EPA's stormwater program at military bases.

Municipal and industrial stormwater discharges are a priority for the agency, as stormwater is the principal cause of numerous water quality problems that affect beaches, lakes, and rivers throughout the United States. Stormwater discharges, with attendant pollutants and erosive capabilities, cause serious and long-standing adverse impacts on receiving waters. The EPA estimates that at least 13% of rivers and streams, 18% of lakes, and 32% of estuaries are impaired primarily by stormwater - and there are many more where stormwater (among other factors) contributes to water quality impairment.

The Congress recognized these impacts when it enacted Section 402(p) of the Clean Water Act in 1987. Regulations requiring permits for larger Municipal Separate Storm Sewer Systems (MS4s) were issued in 1990 (Phase I) and for smaller MS4s in 1999 (Phase II). The Phase II regulations have defined small MS4s since 1999 to include "systems similar to separate storm sewer systems in municipalities, *such as systems at military bases*..." 40 C.F.R. § 122.26(b)(16).

In Section 402(p)(3)(B)(iii) of the Act, Congress required that a permit for discharges from MS4s must "require controls to reduce the discharge of pollutants to the maximum extent practicable," or MEP, and may, at the discretion of the permitting authority, include "other provisions" determined appropriate for the control of such pollutants. In promulgating regulations for MS4 permits in the Phase II rule, the EPA declined to prescribe uniform "maximum extent practicable" permit requirements, but rather provided extensive discussion of how the MEP standard would be applied and what factors a permitting authority should look for in determining what MEP represents for the permitted MS4. In the preamble to the final Phase II rule, the EPA stated:

> "EPA has intentionally not provided a precise definition of MEP to allow maximum flexibility in MS4 permitting. MS4s need the flexibility to optimize reductions in stormwater pollutants on a location-by-location basis. EPA envisions that this evaluative process will consider such factors as conditions of receiving waters, specific local concerns, ... climate, implementation schedules, current ability to finance the program, beneficial uses of receiving water, hydrology, geology, and capacity to perform operation and maintenance." 64 Fed. Reg. at 68754 (Dec. 8, 1999).

In establishing what constitutes maximum extent practicable, the EPA must look at a variety of factors, including available stormwater control technology, the scientific and engineering literature regarding the control of stormwater, current best practices employed by other MS4s, and site specific conditions that are found at the facility.

The Phase II regulations provide a framework for the exercise of the CWA Section 402(p) permitting authority by establishing minimum requirements for MS4 permits. See 40 C.F.R. § 122.34. Phase II MS4 permits "require *at a minimum* that [the permittee] develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from [the] MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act." 40 C.F.R. § 122.34(a) (emphasis added). The stormwater management program "must include the minimum control measures described in paragraph (b) of this section." *Id.* Among the minimum measures is "[p]ost-construction stormwater management in new development and redevelopment." 40 C.F.R. § 122.34(b)(5). These minimum measures include a requirement to develop and implement a program "to address stormwater runoff from *new development and redevelopment* projects that disturb greater than or equal to one acre . . ." and require "strategies which include a combination of structural and/or non-structural best management practices as appropriate for your community." *Id* (emphasis added). The minimum measures for MS4 permits in the Phase II rule were upheld in *Environmental Defense Center v. EPA*, 344 F.3d 832 (9th Cir. 2003).

As a general matter, the EPA, scientists and the regulated community all recognize that stormwater runoff collects and transports pollutants into MS4s and are subsequently discharged into their receiving waters, and that by decreasing the volume of runoff, pollutants discharged from MS4s are reduced.[1] Further, the EPA has long recognized that increased flow rate, velocity and energy of stormwater discharges result from the creation of new impervious surfaces, i.e., development. See e.g., 64 Fed. Reg. 68725 (Dec. 8, 1999). This increase in stormwater velocity and volume results in increased pollutant loadings, and can cause or contribute to water quality impairments, the very problem Congress addressed in 1987. It can alter the physical parameters of waterbodies by widening and incising channels, which fundamentally transforms the natural hydrologic regime with long-term negative impacts on aquatic habitats and biotic interactions.[2] As explained in the Phase II rule preamble with respect to the post-construction minimum measure, "EPA intends to prevent water quality impacts resulting from increased discharges of pollutants, which may result from increased volume of runoff. In many cases, consideration of the increased flow rate, velocity and energy of stormwater discharges following development unavoidably must be taken into consideration in order to reduce the discharge of pollutants, to meet water quality permit conditions and to prevent degradation of receiving streams." 64 Fed. Reg. 68761 (Dec. 8, 1999).

In addition, Section 402(p)(3)(B) was held to provide discretionary authority to the permitting authority to include requirements for reducing pollutants in stormwater discharges as necessary for compliance with water quality standards. "Under that discretionary provision, the EPA has the authority to determine that ensuring strict compliance with state water quality standards is necessary to control pollutants." *Defenders of Wildlife v. Browner*, 191 F.3d 1159, 1166 (9th Cir. 1999). The EPA has also described in the 1996 *Interim Permitting Policy* how permits would implement an iterative process using BMPs, assessment, and refocused BMPs, leading toward attainment of water quality standards. The ultimate goal of the iteration would be for water bodies to support their state-established designated uses. 64 Fed. Reg. at 68753 (Dec. 8, 1999).

It was under these CWA statutory and regulatory authorities that the EPA issued MS4 permits to the Buckley Air Force Base and Joint Base Lewis-McChord. The EPA notes that the Environmental Appeals Board petitions for review of these permits were recently settled.

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[1] See pages 27-28 of the National Research Council's report titled, "Urban Stormwater Management in the United States" http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf.
[2] *See id.* pages 17-21. Also, pages 100-101 of EPA's MS4 Permit Improvement Guide, http://www.epa.gov/npdes/pubs/ms4permit_improvement_guide.pdf.

Your letter discusses a recent decision in the Eastern District of Virginia concerning the establishment of "total maximum daily loads" or "TMDLs" under Section 303(d) of the Act. *Virginia Dep't of Transp. v. EPA*, 2013 U.S. Dist. LEXIS 981 (E.D. Va. Jan. 3, 2013). This case, however, addressed the authority under Section 303 and does not affect the EPA's authority to control stormwater discharges through MS4 permits under Section 402. The court's decision turns on the specific language of CWA Section 303(d)(1)(C), it has no bearing on the EPA's authority to regulate "stormwater discharges," as expressly required under CWA Section 402(p)(6), or to require specific types of controls under CWA Section 402(p)(3)(B)(iii). Unlike Section 303(d), Section 402(p) specifically authorizes – indeed requires – MS4 permits for certain "discharges composed entirely of stormwater," recognizing that all stormwater contains pollutants. 33 U.S.C. § 402(p)(1), (2), (6).

Finally, your letter references the Supreme Court's decision in *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers,* 531 U.S. 159 (2001) and questions whether the EPA's and the Corps' proposed rulemaking would assert CWA jurisdiction over waters that the court found beyond the reach of the CWA. This is an important question. In *SWANCC*, the Court held that the use of "isolated" non-navigable intrastate ponds by migratory birds is itself not a sufficient basis for the exercise of federal regulatory protection under the Clean Water Act. The proposed rule is consistent with this decision and precludes establishing CWA protections for waters based solely on the presence of migratory birds. The agencies are working to ensure the proposed rule is fully consistent with the case law, including decisions of the Supreme Court in *United States v. Riverside Bayview Homes Inc.*, 474 U.S. 121 (1985), *SWANCC*, and *Rapanos v. United States,* 547 U.S. 715 (2006).

Enclosed are electronic versions of documents responsive to your request. If you desire further information in connection with this subject, EPA staff will work with your staff to accommodate any such interest.

Again, thank you for your letter. If you have further questions, please contact me or your staff may contact Cathy Davis in the EPA's Office of Congressional and Intergovernmental Relations at Davis.CatherineM@epa.gov or (202) 564-2703.

Sincerely,

Kenneth J. Kopocis

Kenneth J. Kopocis
Deputy Assistant Administrator

Enclosures

July 2008

Managing Stormwater in Your Community

A Guide for Building an Effective Post-Construction Program

CENTER FOR WATERSHED PROTECTION

EPA Publication No: 833-R-08-001

July 2008

Managing Stormwater in Your Community

A Guide for Building an Effective Post-Construction Program

CENTER FOR WATERSHED PROTECTION

EPA Publication No: 833-R-08-001

Managing Stormwater in Your Community

A Guide for Building an Effective Post-Construction Program

David J. Hirschman, *Center for Watershed Protection, Inc.*
John Kosco, PE, *Tetra Tech, Inc.*

Acknowledgements

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Michael Beezhold, *City of Lenexa, KS*
Rob J. Beilfuss, *City of Lenexa, KS*
T. Andrew Earles, *Wright Water Engineers, Inc*
Jack Faulk, U.S. EPA, *Office of Wastewater Management*
Sally Hoyt, *Biohabitats, Inc.*
Steve Hubble, *Stafford County, VA*
Tom Jacobs, *City of Lenexa, KS*
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Fernando Pasquel, *Michael Baker, Inc.*
Robert D. Patterson, *North Carolina Department of Environment and Natural Resources*
James Pease, *Vermont Department of Environmental Conservation*
Lynn Richards, *U.S. EPA, Office of Policy, Economics, and Innovation*
Jennifer Zielinski, *Biohabitats, Inc.*
Local stormwater managers in 94 communities who responded to the post-construction research tool.

Various staff from the Center for Watershed Protection and Tetra Tech assisted with the technical content and administrative tasks associated with the guide:

Center for Watershed Protection, Inc.
Lindey Brown, Karen Cappiella, Deb Caraco, Greg Hoffmann, Lauren Lasher, Mike Novotney, Chris Swann, Laurel Woodworth

Tetra Tech, Inc.
Garrett Budd, Jim Collins, Martina Keefe, Marti Martin, Kristin Schatmeyer, Regina Scheibner, Christy Williams

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Albemarle County, Virginia
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Greg Hoffmann
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Foreword

Stormwater management is witnessing a growth in creative approaches. Stormwater managers across the country are incorporating stormwater treatment into landscapes and streetscapes. Stormwater is being captured and reused for a variety of beneficial uses. Stormwater treatment is being incorporated from the rooftop to the conveyance system to the stream edge. Stormwater is being integrated with land use plans to enhance community benefits and water quality. A variety of professionals—engineers, landscape architects, community planners, hydrologists, and public works staff (to name a few)—are now engaged in the challenge of managing stormwater in innovative ways.

At the same time, many communities are trying to build adequate programs to meet regulatory and community demands. Stormwater managers are trying to tackle complex issues with limited budgets and staffing.

In putting together the guide, we have polled local stormwater managers from across the country and gleaned important lessons and tips. It is our hope that this guide will provide stormwater professionals with practical guidance, insights, and tools to build effective programs.

The guide is accompanied by several downloadable "tools." The tools are designed to be used and modified by local stormwater managers to help with program implementation. The tools are described in more detail in Chapter 1, and can also be downloaded from the Center for Watershed Protection at *www.cwp.org/postconstruction.*

A note on web links: We have provided numerous web links within the document to ease the task of finding relevant resources. However, links tend to become unreliable through time, especially for references to individual documents (such as pdfs). If you find a broken link, try to shorten the link to the relevant agency or department name to search for the document or page. Also, contact *center@cwp.org* to report broken links.

Contents

The following electronic tools are available at www.cwp.org/postconstruction:

Tool 1 – Post-Construction Stormwater Program Self-assessment

Tool 2 – Program and Budget Planning Tool

Tool 3 – Post-Construction Stormwater Model Ordinance

Tool 4 – Codes and Ordinances Worksheet

Tool 5 – Manual Builder

Tool 6 – Checklists

Tool 7 – Performance Bond Tool

Tool 8 – BMP Evaluation Tool

Tables

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Post-Construction Stormwater Management Glossary: *Towards a Common Language*

As stormwater management has evolved, so has the language used to describe certain practices and techniques. At this point, the terminology of stormwater can be confusing—largely because multiple terms are used to describe similar and overlapping concepts. Are we building stormwater BMPs, stormwater treatment practices, or structural measures? Is our innovative design approach known as low-impact development, better site design, environmental site design, non-structural measures, or green infrastructure?

This guide uses certain terminology, and it is important to understand the meaning of these terms as it relates to the material within the guidance. This is not an attempt to be definitive with regard to the terminology, as it is certain to evolve over time. Also, the list below is not exhaustive, as a much fuller list of terms can be found in most stormwater ordinances, regulations, and manuals, including the Post-Construction Model Ordinance provided in Tool 3 (*www.cwp.org/postconstruction*).

Combined Sewer Overflow (CSO)

Combined sewer systems are sewer systems that collect both stormwater runoff and sanitary sewage in the same pipe to be carried to a wastewater treatment plant. Wet weather events can sometimes cause these combined sewer systems to exceed their hydraulic capacity and result in a combined sewer overflow (CSO). A CSO can result in untreated human and industrial waste, toxic materials and debris being discharged to nearby streams, rivers, lakes or estuaries, impacting water quality and aquatic habitat. CSOs can cause beach closings, shellfishing restrictions and other water body impairments.

Environmental Site Design (ESD)

Environmental Site Design (ESD) is an effort to mimic natural systems along the whole stormwater flow path through combined application of a series of design principles throughout the development site. The objective is to replicate forest or natural hydrology and water quality. ESD practices are considered at the earliest stages of design, implemented during construction and sustained in the future as a low maintenance natural system. Each ESD practice incrementally reduces the volume of stormwater on its way to the stream, thereby reducing the amount of conventional stormwater infrastructure required. Example practices include preserving natural areas, minimizing and disconnecting impervious cover, minimizing land disturbance, conservation (or cluster) design, using vegetated channels and areas to treat stormwater, and incorporating transit, shared parking, and bicycle facilities to allow lower parking ratios.

The Center for Watershed Protection has published information on this concept using the term "Better Site

Design." For more information, see: *Better Site Design: A Handbook for Changing Development Rules in Your Community*, Center for Watershed Protection, Inc. *www.cwp.org* > Online Store > Better Site Design.

Green Infrastructure

Green infrastructure refers to natural systems that capture, cleanse and reduce stormwater runoff using plants, soils and microbes. On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities, wildlife habitat, air quality and urban heat island benefits, and other community benefits. At the site scale, green infrastructure consists of site-specific management practices (such as interconnected natural areas) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls.

Additional information on green infrastructure is available from EPA at *www.epa.gov/npdes/greeninfrastructure*

Low-Impact Development (LID)

Low-Impact Development (LID) is a stormwater management approach that seeks to manage runoff using distributed and decentralized micro-scale controls. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Instead of conveying and treating stormwater solely in large end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small-scale landscape practices and design approaches that preserve natural drainage features and patterns. Several elements of LID—such as preserving natural drainage and landscape features—fit right into the Green Infrastructure approach. Additional information on LID is available at *http://www.epa.gov/owow/nps/lid*.

Municipal Separate Storm Sewer System (MS4)

A Municipal Separate Storm Sewer System (MS4) is a publicly owned conveyance or system of conveyances that discharges to waters of the United States or waters of the state, and is designed or used for collecting or conveying stormwater. Conveyances can include any pipe; ditch or gully; or system of pipes, ditches, or gullies, that is owned or operated by a governmental entity and used for collecting and conveying stormwater. Discharges from MS4s are regulated under the NPDES municipal stormwater program (Phase I and Phase II).

Non-Structural BMP

Non-structural BMPs are used in lieu of or to supplement structural BMPs. Non-structural measures may include minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and vegetated areas that intercept roof and driveway runoff. In this regard, "non-structural BMP" is a generic term for many of the techniques under the umbrellas of Green Infrastructure and Low-Impact Development. Non-structural BMPs can also refer to program elements aimed at changing behaviors that lead to polluted runoff. Examples include storm drain stenciling, outreach programs, and yard fertilizer education programs.

Post-Construction Stormwater

This terminology is used to distinguish stormwater practices used during site construction (otherwise known as "construction stormwater" or "erosion and sediment control") from those that are used on a permanent basis to control runoff once construction is complete ("post-construction stormwater"). Construction stormwater is minimum measure #4 in the Phase II municipal stormwater permit program, and post-construction stormwater is minimum measure #5.

Smart Growth

Smart Growth refers to coordinated planning to support economic, community and environmental goals. Smart Growth focuses on planning where development is located in relationship to urban infrastructure and environmental features, and is a big-picture way to manage the overall footprint of impervious surfaces at the neighborhood, watershed, and community scales. Smart Growth encourages infill and redevelopment within designated areas as a way to keep the development footprint from expanding across important rural and natural resources areas. Smart Growth also encourages the coordination of utility plans, transportation plans, economic development plans, stormwater codes, design guidelines, and other policies to achieve the best outcomes for the economy and environment. For more information visit: *http://www.epa.gov/smartgrowth/*

Stormwater BMP

BMP refers to "best management practice." It is a generic term that has been used interchangeably with stormwater practice or stormwater treatment practice. Stormwater BMPs can be either "structural" or "non-structural."

Structural BMP

Structural BMPs generally require construction supported by engineering plans, and become permanent features of the landscape. Examples include ponds, wetlands, underground or surface chambers or filters, bioretention areas, swales, and infiltration trenches.

Total maximum daily load (TMDL)

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

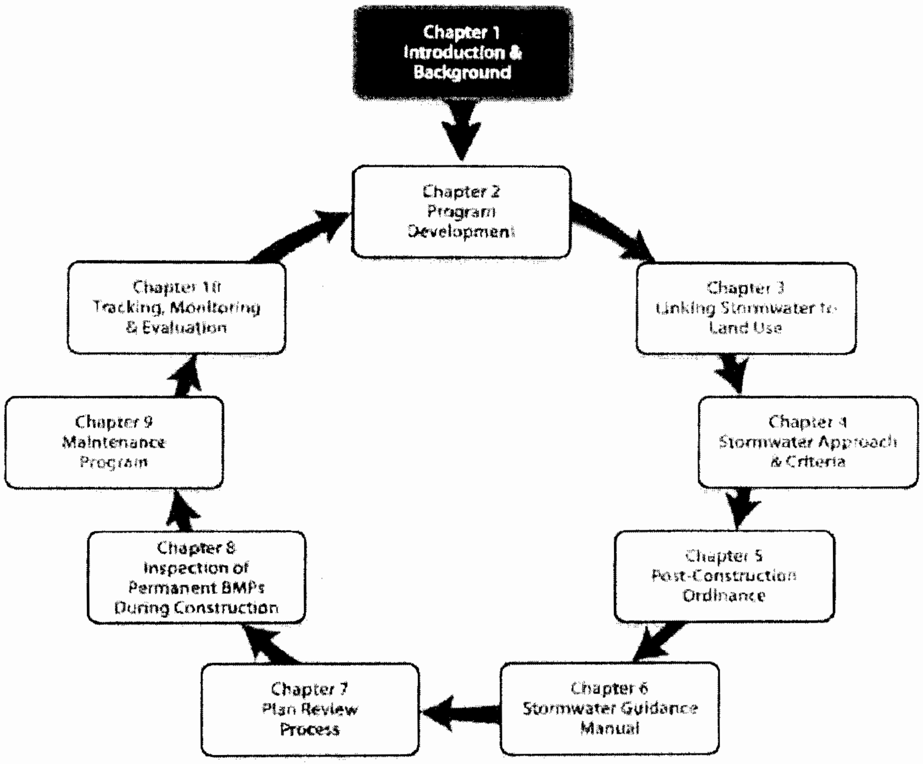
A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality.

Watershed Management

A watershed is the land area from which water drains into a stream, channel, lake, reservoir, or other body of water. Many communities are using the watershed management framework to address the intersection of land development and water quality/quantity. Watershed management often involves multi-jurisdictional collaboration to identify and address cross-boundary water quality problems and flooding.

Chapter 1

Introduction and Background



What's In This Chapter

- Post-Construction Stormwater Basics and the Guidance Manual
- Relationship of Post-Construction Stormwater Management to:
  - Construction Stormwater Management
  - Impaired Waters (TMDLs)
  - Combined Sewer Overflows
  - Stormwater Retrofitting
- Regulatory Background
- Current Trends and Recommendations for Post-Construction Stormwater Management

Download Post-Construction Tools at:
www.cwp.org/postconstruction

1.1. Introduction

Communities across the country are increasingly viewing stormwater management as an opportunity to improve the environment, create attractive public and private spaces, engage the community in environmental stewardship, and remedy the ills of the past, when development took place with inadequate stormwater controls.

While stormwater management has enjoyed a higher profile in recent times, communities across the country are striving to build the programmatic capabilities to effectively manage stormwater and meet regulatory requirements, such as Phases I and II of the National Pollutant Discharge Elimination System (NPDES) municipal stormwater permit program.

Many local programs have a strong emphasis on the stormwater basics of providing flood control and adequate drainage. Recently, many stormwater programs have become more sophisticated and "greener" by incorporating channel protection, groundwater recharge, protection of sensitive receiving waters, control of the overall volume of stormwater runoff, and use of natural systems and site design techniques to control runoff.

Water quality impacts from urban runoff can be significant. Many streams, lakes, and estuaries in urban areas are impaired due to urban runoff (*http://iaspub.epa.gov/waters10/attains_nation_cy.control*). Impervious surfaces, disturbed soils, and managed turf associated with urban development can have multiple impacts on water quality and aquatic life. These impacts are summarized in Table 1.1.

Urban development can also impact the post-development hydrograph discharging to urban streams (**Figure 1.1**). Compared to the pre-development condition, post-development stormwater discharges can increase the runoff volume, increase the peak discharge, and decrease the infiltration of stormwater, which thereby decreases baseflow in headwater streams. These changes to stream hydrology result in negative impacts on channel stability and the health of aquatic biological communities. Common problems include bank scouring and erosion, increased downstream flooding, and loss of in-stream habitat for macroinvertebrates, fish, and other organisms.

Table 1.1. Summary of Development Impacts on Water Resources

Increases in:	Decreases in:
Impervious cover, compacted soils, managed turf, and other land covers that contribute pollutants	Health and safety of receiving waters
Stormwater volume	Groundwater recharge
Stormwater velocity	Stream channel stability
Pollutant loads	Health, safety, and integrity of water supplies, reservoirs, streams, and biological communities
Stream channel erosion	Stream habitat

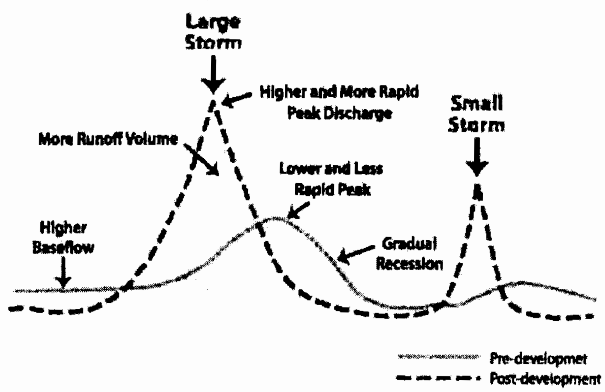


Figure 1.1. Urban development increases runoff volume, peak discharge, and time to peak

Purpose and Audience for this Guide

This guide is intended for Phase II NPDES Municipal Separate Storm Sewer System (MS4) communities (which are required to establish a post-construction program), as well as other smaller unpermitted MS4s that are interested in protecting local water resources. Other entities responsible for implementing post construction controls, such as military bases, transportation departments, and school districts, will also find this guide useful. Stormwater Phase I and other communities already implementing a post-construction program could benefit from the program assessment described in **Section 2.2** and other sections of the guide to help them identify key areas for improvement.

Finally, this guide is intended for multiple audiences within a local government. The guide recognizes the important link between overall comprehensive land use planning and the more technical components of a stormwater program. Often, land use planners and stormwater managers do not collaborate on large-scale land use and development issues. However, the activities of both groups have a profound impact on the health of watersheds and receiving waters. The guide, and especially **Chapter 3**, is meant to bridge this gap and promote a stronger link.

What's in the Guide

The guide contains chapters that address key elements of a post-construction program, and also several companion "tools." The tools are designed to be downloaded and adapted by local programs to help build program capabilities. The chapters and tools in the guide are listed in **Table 1.2. Figure 1.2** portrays the chapters of the guide in graphical format, showing the cyclical or iterative nature of the various program elements.

Table 1.2. Contents of Post-Construction Guidance Manual

Chapters	Description
Chapter 1 Introduction and Background	Introduces the contents of the guide and related tools. Provides a brief regulatory background on post-construction stormwater management.
Chapter 2 Post-Construction Program Development	Provides the stormwater manager with an understanding of the community and watershed components of a stormwater plan and introduces a program self-assessment tool. *Companion to Tool 1: Self-Assessment and Tool 2: Program and Budget Planning Tool*
Chapter 3 Land Use Planning as the First BMP: Linking Stormwater to Planning	Examines the link between stormwater and land use planning. Details how to build a more effective program through integrated stormwater and planning tools. *Companion to Tool 4: Codes and Ordinance Worksheet*
Chapter 4 Developing a Stormwater Management Approach and Criteria	Introduces a recommended stormwater management approach and how to distill this approach into criteria for a stormwater ordinance and guidance manual. *Companion to Tool 5: Manual Builder*
Chapter 5 Developing a Post-Construction Stormwater Ordinance	Works through the nuts and bolts of building a stormwater ordinance and illustrates major decision points. *Companion to Tool 3: Model Ordinance*
Chapter 6 Developing a Stormwater Guidance Manual	Reviews stormwater policy and design guidance from A to Z. Includes tips for building a manual that best suits the community. *Companion to Tool 5: Manual Builder*
Chapter 7 The Stormwater Plan Review Process	Delves into the anatomy of a good review process and how to use it to ensure good BMP design and long-term maintenance. *Companion to Tool 6: Checklists*
Chapter 8 Inspection of Post-Construction BMPs during Construction	Offers guidance on the process for initial installation of post-construction BMPs during the construction phase. *Companion to Tool 6: Checklists and Tool 7: Performance Bonds*

Table 1.2. Contents of Post-Construction Guidance Manual *(continued)*

Chapters	Description
Chapter 9 Developing a Maintenance Program	Explores three models for a maintenance program and provides tips for an effective program. *Companion to Tool 5: Manual Builder, Tool 6: Checklists and Tool 7: Performance Bonds*
Chapter 10 Tracking, Monitoring, and Evaluation	Reviews the development of measurable goals and milestones. Provides guidance on program evaluation, annual reports, and preparing for a possible program audit. *Companion to Tool 8: BMP Evaluation Tool*
Tools	**Description**
Tool 1 Post-Construction Stormwater Program Self-assessment	Evaluates the current status of the program, and where it needs to go. This checklist tool can be used to set short- and long-term goals.
Tool 2 Program and Budget Planning Tool	Provides planning milestones and assists with development of planning-level budget figures using a spreadsheet.
Tool 3 Post-Construction Stormwater Model Ordinance	Provides model language to build or enhance the ordinance. Language is keyed to three levels of program sophistication.
Tool 4 Codes and Ordinance Worksheet	Assesses zoning, subdivision, and other codes in the context of impervious cover creation and ability to promote effective stormwater management through design.
Tool 5 Manual Builder	Provides links to the best design and program resources around the country. Useful for stormwater managers who are developing a manual or adapting an existing manual.
Tool 6 Checklists	Provides detailed checklists for plan review, best management practice (BMP) installation during construction, and maintenance. The checklists address both structural and nonstructural stormwater BMPs.
Tool 7 Performance Bond Tool	Supplies templates that can be adapted to develop a performance bond for the program—an effective tool to ensure good BMP installation.
Tool 8 BMP Evaluation Tool	Asks the right questions when it comes to verifying the performance of various BMPs, especially proprietary devices.

Download Tools at: *www.cwp.org/postconstruction*

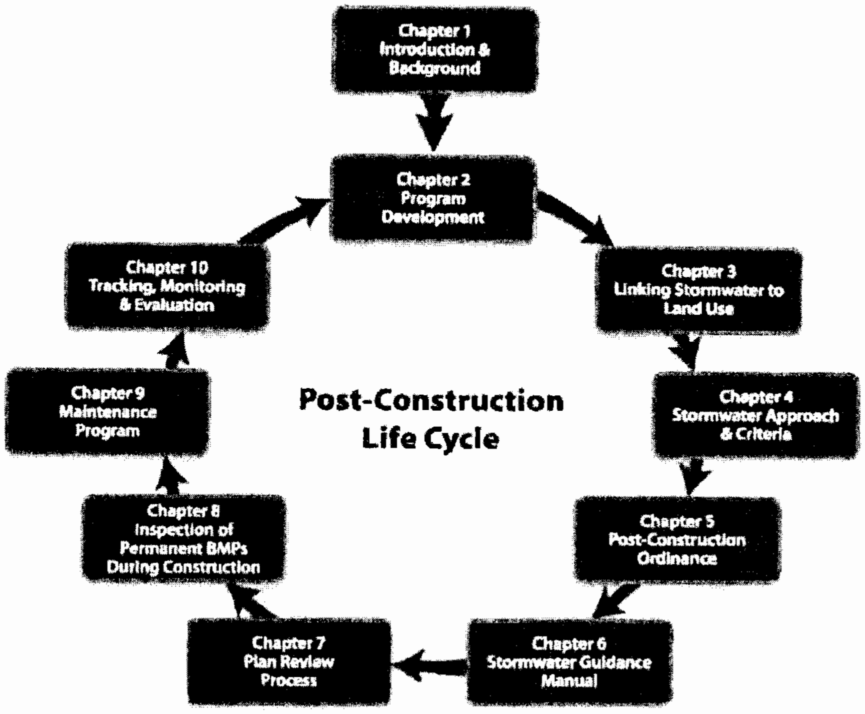


Figure 1.2. The Post-Construction Stormwater Life-Cycle, as presented in this guide. The program elements are presented in a cyclical or iterative format, as programs evolve.

1.2. Relationship of Post-Construction to Construction Stormwater (Erosion and Sediment Control)

This guide addresses runoff from projects after the construction phase is complete. Stormwater runoff from projects during active construction is typically addressed through requirements for stormwater pollution prevention plans (SWPPPs) and erosion and sediment control BMPs. Guidance on developing SWPPPs for construction projects is available from EPA (see *Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites* at *http://www.epa.gov/npdes/swpppguide*).

A local program must carefully consider the relationship between construction and post-construction stormwater. Construction stormwater BMPs listed in a SWPPP are designed to minimize impacts during the active construction phase, and they do not always translate into BMPs applicable for post-construction. Post-construction BMPs must treat runoff from the newly constructed or redeveloped site, including runoff from roads, parking lots, yards, rooftops, and other land uses associated with development.

In some cases, construction and post-construction BMPs can be located in the same area, such as a sediment control basin or trap converted to a permanent stormwater BMP. Colocating construction and post-construction BMPs can help a designer follow natural drainage patterns, can be an economical approach, and often works when proper construction sequencing and standards are followed (see **Table 1.3** for more details).

However, increasingly, it is being found that construction and post-construction BMPs should be located on different parts of the site and have different sizing and design criteria. For instance, post-construction BMPs might involve practices distributed across the site, such as bioretention and infiltration practices. In this case, the post-construction BMP locations must be carefully protected during the construction phase in order to preserve the soil structure necessary for long-term BMP effectiveness. Also, the post-construction BMPs must be installed in the proper construction sequence—*after* contributing drainage areas are stabilized—in order to prevent construction sediment runoff from clogging the newly installed bioretention or infiltration practices. **Figure 1.3** portrays typical coordination needs between construction and post-construction stormwater planning.

Table 1.3 notes several other dos and don'ts with regard to coordinating construction and post-construction BMPs.

Table 1.3. Coordination Between Construction and Post-Construction Stormwater

DO:

- Coordinate plan review for construction and post-construction BMPs.
- Make sure the Limits of Disturbance (LODs) for the SWPPP (construction stormwater plan) are coordinated with natural areas and open-space areas that are supposed to be protected per the post-construction plan.
- Make sure that areas designated for post-construction BMPs are protected from disturbance and compaction during construction and are noted in the SWPPP. This is especially true for infiltration and bioretention practices that depend on an undisturbed soil structure.
- Colocate construction and post-construction BMPs where it makes sense and won't compromise the integrity of post-construction BMPs. Good candidates for colocation include:
  - Basins that will be converted from construction to post-construction configurations by dredging construction sediments and modifying outlet structures
  - Sediment traps that will be converted to bioretention/filtration (or another BMP) when, after drainage areas are stabilized, construction sediments are removed and the basin floor is excavated to a deeper layer (below the original sediment trap invert) with good soils for infiltration
  - Other cases where the local program staff can ensure the integrity of the post-construction BMPs
  - Care should especially be taken with infiltration facilities to avoid conflicts between construction and post-construction BMPs and compaction of soils.
- Make sure that inspectors and contractors are aware of both construction and post-construction BMPs to be installed at a site.

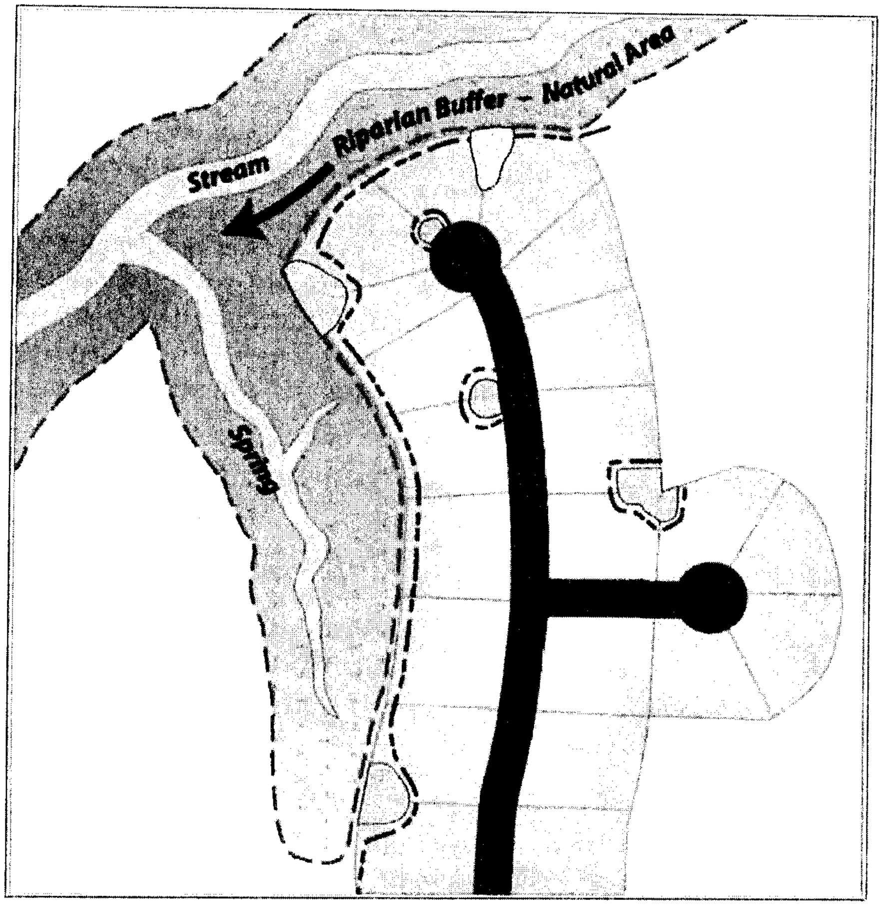
DON'T:

- Approve a SWPPP that conflicts with a post-construction stormwater plan in terms of protection of natural areas, tree protection, limits of disturbance, etc.
- Colocate construction and post-construction BMPs where soil compaction and sedimentation will damage the integrity of the post-construction BMP.
- Suspend inspections or release performance bonds until the post-constructions BMPs have been installed correctly.

1.3. Relationship of Post-Construction to Impaired Waters (TMDLs)

Under the authority of section 303(d) of the Clean Water Act, waterbodies that do not meet water quality standards are considered "impaired" and a "Total Maximum Daily Load" (TMDL) study must be conducted. This study computes the pollutant load that a waterbody can receive and still meet water quality standards, and it allocates this load to various point and nonpoint sources. Authorized states and tribes administer the TMDL program.

Currently, thousands of impaired waters are listed on state 303(d) lists. The most common sources of impairment associated with stormwater include sediment, pathogens (bacteria), nutrients, and metals (**USEPA, 2007**). Stormwater and urban and suburban runoff are significant contributors to impairments nationwide and the leading cause of impairments within some regions (**USEPA Region 5, 2007**). For this reason, EPA and relevant state agencies are increasingly motivated to create a stronger link between TMDLs and stormwater permits, such as MS4, construction site, and industrial permits. Future rounds of MS4 permit coverage will seek more targeted and/or stringent stormwater controls for impaired watersheds within the jurisdiction of MS4s.



— — — — Riparian buffer/natural area boundary

Colocated construction-phase sediment basin and post-construction BMP.

Post-construction bioretention/infiltration area — Soil must be protected during construction. Do ***not*** use for construction-phase BMPs *unless specific conditions are met (Table 1.3).*

— - - — - - Limits of Disturbance (LOD) for construction-phase SWPPP — Must protect riparian buffer and post-construction infiltration area. Fencing recommended.

Figure 1.3. Construction stormwater and post-construction stormwater plans must be coordinated to protect post-construction design features and BMPs

For the local stormwater manager, this will require an effort to tailor certain stormwater criteria and BMPs to help meet TMDL pollutant-reduction benchmarks. **Chapter 4 (Table 4.17)** provides more detail on creating a stronger link between stormwater criteria and TMDLs.

1.4. Relationship of Post-Construction to Combined Sewer Overflows (CSOs)

Many communities in the past built combined sewer systems that collect both stormwater runoff and sanitary sewage in the same pipe to be carried to a wastewater treatment plant. Wet weather events can sometimes cause these combined sewer systems to exceed their hydraulic capacity, resulting in combined sewer overflows (CSOs). A CSO can result in untreated human and industrial waste, toxic materials, and debris being discharged to receiving waterbodies, impacting water quality and aquatic habitat. CSOs cause beach closings, shellfishing restrictions, and other waterbody impairments. Combined sewer systems serve roughly 772 communities containing about 40 million people. (See EPA's NPDES Web site, accessed November 2007: *www.epa.gov/npdes/cso*)

EPA's Combined Sewer Overflow Control Policy is the national framework for the control of CSOs through the NPDES permitting program (*www.epa.gov/npdes/pubs/owm0111.pdf*). The Policy includes a set of Nine Minimum Control Measures designed to address the causes of CSOs and limit their occurrence:

1. Monitoring to effectively characterize impacts from CSO discharges
2. Proper operation and maintenance programs
3. Maximum use of the collection system for storage
4. Review and modification of pretreatment programs
5. Maximizing flows to the wastewater treatment plant
6. Prohibiting dry weather CSO discharges
7. Control of solids and floatable materials
8. Pollution prevention programs
9. Public notification

Many of the measures required for CSO control can be directly related to post-construction stormwater management. For instance, the volume and frequency of CSO events can be reduced by implementing stormwater management practices that reduce the volume and rates of runoff. Treatment of stormwater runoff before it enters the combined sewer system also reduces the level of pollutants potentially discharged in an overflow event. Pollution prevention programs focused on reducing the exposure of pollutants to runoff entering a combined sewer system also help eliminate excess nutrients and other pollutants.

1.5. Relationship of Post-Construction to Stormwater Retrofitting

Stormwater retrofitting refers to a series of techniques that help to restore watersheds by providing stormwater treatment in locations where practices previously did not exist or were ineffective. Stormwater retrofits are typically installed at older, existing stormwater facilities, within the conveyance system, above or below outfalls, at stormwater hotspots, and at other locations that are close to the source of runoff. The intent is to capture and treat stormwater runoff ***before*** it is delivered to the receiving waters (**Schueler et al. 2007**).

Retrofitting spans the regulatory and non-regulatory sides of post-construction stormwater management:

- In a *regulatory* sense, the MS4 requirements pertain to new development and redevelopment projects. Redevelopment cases, in particular, are places where retrofitting can play a major role. For instance, existing stormwater facilities and/or conveyance systems can be retrofitted to provide better water quality treatment.
- In the *non-regulatory* context, retrofitting is a critical tool to help achieve watershed restoration goals, especially in watersheds where much of the development took place prior to modern stormwater management. For these communities, a retrofit program can be built into the overall post-construction program to help fulfill MS4 commitments.

When tailored to a community's watershed needs, retrofitting can help meet multiple objectives. For instance, a retrofitting program can reduce runoff volumes in combined sewer systems; help reduce the amount of trash and floatables reaching waterbodies; support downstream stream restoration projects; help solve existing flooding, erosion, and water quality problems; and provide key demonstration and outreach projects (Schueler et al. 2007).

Table 1.4 lists several ideas for how retrofitting can be integrated with the six minimum measures in the Phase II MS4 program.

To assist communities with a retrofitting program, the Center for Watershed Protection has produced a comprehensive guidance manual on stormwater retrofitting: *Urban Stormwater Retrofit Practices, Version 1.0*, Urban Subwatershed Restoration Manual Series, Manual 3 (August 2007). *www.cwp.org* > Resources > Controlling Runoff & Discharges > Stormwater Management > National/Regional Guidance.

Table 1.4. Integrating Stormwater Retrofitting with the Six Minimum Measures

Minimum Measure	How Retrofitting Can Help
1. Public Education and Outreach	• Use high-visibility public sites for retrofit projects and include educational signage and interpretation. • Use retrofit demonstration sites for outdoor classrooms, educational events, and field trips.
2. Public Participation and Involvement	• Get citizen advisory committees involved in establishing retrofit objectives and candidate locations. • Use volunteer labor to help with retrofit project light construction, planting, mulching, and maintenance
3. Illicit Discharge Detection and Elimination	• Use the retrofit field reconnaissance process to look for illicit discharges.
4. Construction Site Runoff Control	• Use retrofit projects to demonstrate proper erosion and sediment control to the development community. • Look for construction sites during the retrofit field reconnaissance process, and conduct follow-up inspections.
5. Post-Construction Runoff Control	• Establish retrofitting protocols for redevelopment sites. • In some cases, have a developer do an on-site or off-site retrofit to satisfy post-construction requirements. • In some cases, collect a fee-in-lieu payment from a developer to help pay for strategic retrofits in the watershed. • Build retrofitting into the facilities planning, capital improvements, and facilities maintenance program.
6. Pollution Prevention and Good Housekeeping	• Include pollution prevention and landscape stewardship projects in the retrofit program. Start with public sites, such as schools, parks, and public works yards, and incorporate findings into ongoing maintenance activities. • Look for opportunities to retrofit water quality treatment at municipal stormwater hotspots, such as vehicle maintenance, fueling, public works, and grounds maintenance facilities. • Use stormwater retrofit projects to set a good example for the development community and public.

1.6. Regulatory Background for Post-Construction Stormwater

Both Phase I and Phase II of the NPDES stormwater program require municipalities to develop and implement programs to address stormwater runoff from areas of new development and redevelopment (i.e., post-construction runoff). The Phase I post-construction requirements are at 40 CFR Part 122.26(d). There are approximately 1,000 Phase 1 permittees across the country (**U.S. GAO, 2007**).

The stormwater Phase II post-construction requirements are at 40 CFR 122.34(b)(5) and listed in **Table 1.5**. Because the Phase II regulations apply to smaller communities, there are many more of them, currently numbering over 5,000 nationally (**U.S. GAO, 2007**). Additionally, nontraditional MS4s in urbanized areas such as military bases, public universities, and other governmental facilities are also regulated under Phase II.

Authorized states and EPA regions use these Phase I and Phase II regulations as the basis for developing permit requirements for MS4s. The NPDES MS4 permits provide more detailed requirements that MS4s must meet. In response to these permit requirements, MS4s develop detailed plans (often called Stormwater Management Plans) that describe the activities and milestones that the MS4 will meet over the five-year permit term.

Some states also have developed post-construction standards and/or stormwater guidance manuals to implement the stormwater regulations. **Tool 5: Manual Builder** includes information on many state stormwater manuals and their associated Web sites.

The NPDES MS4 requirements are one of the various federal, state, and local regulations and programs that influence stormwater management and land development practices. **Table 1.6** lists other drivers that have some connection to stormwater management. A local program must understand this complex regulatory environment to avoid conflicts and build a sustainable program. Legal issues, such as court rulings involving negligence and nuisance, can also drive the implementation of stormwater management at the local and state levels.

1.7. Current Trends and Recommendations for Post-Construction Stormwater Management

The Center for Watershed Protection recently conducted research that canvassed local government stormwater professionals across the country (**CWP, 2006**). Respondents provided local information and insights on a range of post-construction issues. Almost 100 different local governments across 30 states responded, and the vast majority of respondents were from Phase II communities.

Table 1.7 provides a summary of the current status and trends in post-construction stormwater management based on this research. The table also lists recommended actions and references the appropriate chapters of this guide for more detailed information.

Table 1.5. EPA Stormwater Phase II Minimum Measure for Post-Construction Stormwater Management in New Development and Redevelopment (40 CFR 122.34(b)(5))

(i) You must develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts.

(ii) You must:

(A) Develop and implement strategies which include a combination of structural and/or non-structural best management practices (BMPs) appropriate for your community;

(B) Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State, Tribal or local law; and

(C) Ensure adequate long-term operation and maintenance of BMPs.

(iii) Guidance: If water quality impacts are considered from the beginning stages of a project, new development and potentially redevelopment provide more opportunities for water quality protection. EPA recommends that the BMPs chosen: be appropriate for the local community; minimize water quality impacts; and attempt to maintain pre-development runoff conditions. In choosing appropriate BMPs, EPA encourages you to participate in locally-based watershed planning efforts which attempt to involve a diverse group of stakeholders including interested citizens. When developing a program that is consistent with this measure's intent, EPA recommends that you adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing your program, you should consider assessing existing ordinances, policies, programs and studies that address storm water runoff quality. In addition to assessing these existing documents and programs, you should provide opportunities to the public to participate in the development of the program. Non-structural BMPs are preventative actions that involve management and source controls such as: policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; policies or ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure; education programs for developers and the public about project designs that minimize water quality impacts; and measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas. Structural BMPs include: storage practices such as wet ponds and extended-detention outlet structures; filtration practices such as grassed swales, sand filters and filter strips; and infiltration practices such as infiltration basins and infiltration trenches. EPA recommends that you ensure the appropriate implementation of the structural BMPs by considering some or all of the following: pre-construction review of BMP designs; inspections during construction to verify BMPs are built as designed; post-construction inspection and maintenance of BMPs; and penalty provisions for the noncompliance with design, construction or operation and maintenance. Storm water technologies are constantly being improved, and EPA recommends that your requirements be responsive to these changes, developments or improvements in control technologies.

Table 1.6. Other Regulatory Drivers That Influence Post-Construction Stormwater

Regulatory Driver	Link With Post-Construction Program
Federal (many programs passed down to states for administration)	
NPDES Stormwater Permits for Construction *www.epa.gov/npdes/stormwater/construction*	Applies to stormwater discharges from sites with disturbance of 1 acre or greater. Requires control of sediment and erosion and other wastes at the site. Operators must develop and implement a stormwater pollution prevention plan (SWPPP). Provides opportunity for local program to coordinate construction and post-construction phases in plan review, inspection, and maintenance.
NPDES Stormwater Permits for Industrial Activities *www.epa.gov/npdes/stormwater/msgp*	Applies to stormwater discharges from certain categories of industrial activity. Requires site-specific SWPPP. Post-construction program should ensure that new industrial facilities are designed to prevent pollution and treat stormwater runoff from industrial areas.
Other NPDES Permits (e.g., wastewater discharge, etc.) *www.epa.gov/npdes*	Regulates discharges of process wastewater from municipal, commercial, and other wastewater treatment facilities.
Combined Sewer System – Long-Term Control Plan (NPDES) *www.epa.gov/npdes/cso*	Requires plan to address and minimize overflows from combined systems to waters of the U.S. Some communities have both an MS4 and a combined sewer system, and management practices should be coordinated. For instance, practices that limit the volume of stormwater discharges can also help reduce the incidence of CSOs. In addition, treatment practices such as street sweeping and catch basin cleaning can reduce floatables and sediment in CSOs.
Total Maximum Daily Load (TMDL) *www.epa.gov/owow/tmdl*	Addresses impaired waters through a program that develops total maximum daily loads (TMDLs). A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Post-construction programs specify stormwater practices, retrofits, and/or site-based load limits for development and redevelopment that can address the pollutant(s) identified in the TMDL.
Source Water Assessment Program, Wellhead Protection Program, and Underground Injection Control Program *www.epa.gov/ogwdw*	Identifies and maps potential threats to water supply sources, and recommends protection plans. Stormwater facilities and retrofits can help protect water supply watersheds and wellhead areas. Certain practices may be limited, such as infiltration within wellhead protection areas. Hotspot land uses and discharges may be restricted.
Federal Wetland Permits (Section 404) *www.epa.gov/wetlands*	Regulates the discharge of dredged and fill material into waters of the United States, including wetlands. Stormwater practices that negatively impact streams and wetlands require permitting and are subject to denial. May push programs and site choices into low-impact development strategies to avoid impacts. Stormwater plans may have to be coordinated with mitigation plans required through the wetland permitting process.
Coastal Zone Management Program (CZMP) *http://coastalmanagement.noaa.gov*	Sets out planning goals and milestones for designated coastal zones. Stormwater controls should be coordinated with state-specific coastal zone management plans, which may include BMP performance standards. Nonstructural measures, such as wetland and marsh protection, can be incorporated into stormwater strategy to mesh with CZMP objectives.

Table 1.6. Other Regulatory Drivers That Influence Post-Construction Stormwater *(continued)*

Regulatory Driver	Link With Post-Construction Program
Homeland Security *www.dhs.gov* and *www.epa.gov/watersecurity*	Includes protection of drinking water supplies and wastewater systems as elements of the homeland security efforts of EPA and DHS. The Federal Emergency Management Agency (FEMA) is also a Homeland Security agency, and participation in the National Flood Insurance Program (NFIP) can be influenced by floodplain development policies and stormwater management.
National Flood Insurance Program *www.fema.gov/about/programs/nfip*	Allows local program to set standards for stormwater facilities located in floodplains (especially if fill is required) to ensure that flood conveyance is not impeded. Stormwater facilities may be factored into local floodplain modeling
State (variable by state)	
Dam Safety Program	Establishes regulatory overlay for impounding structures over a certain size or capacity, requiring regulatory coordination between local and state programs.
State Erosion and Sediment Control and Stormwater Programs	Provides performance and/or technology standards for construction stormwater plans and facilities. In most cases, requires coordination between construction and post-construction program elements, such as plan reviews and inspections.
State Water Supply Criteria	Where present, establishes standards for water supply planning and management that may include buffers and setbacks and/or stormwater treatment criteria. These should be coordinated with the local program.
State Scenic River, Open Space, Reforestation, and Resource Protection Programs	Where present, includes state-specific goals with link to stormwater management, such as setbacks from particular rivers.
State Well and Septic Permitting Programs	Provides standards for location of wells and septic fields that may impact on-lot practices, such as rain gardens and dry wells.
Regional	
Specific Regional Efforts; e.g., Chesapeake Bay, Great Lakes, Puget Sound	Where present, provides regional plans and programs that may have goals, objectives, and/or standards that influence a local stormwater program.
Local	
Existing Codes for Erosion Control, Stormwater, Zoning, Subdivision, Standing Water and Weeds (Nuisance), etc.	Establishes local rules for development density, streets, setbacks, etc. These codes may either support or impede stormwater program goals that aim to reduce impervious cover.
Greenway, Open Space, Recreation Plans, etc.	Provides planning framework that offers opportunity for coordination between stormwater and planning (e.g., riparian restoration in conjunction with greenway development, stormwater demonstration sites at public parks).

Table 1.7. Current Trends and Recommended Actions for Post-Construction Program

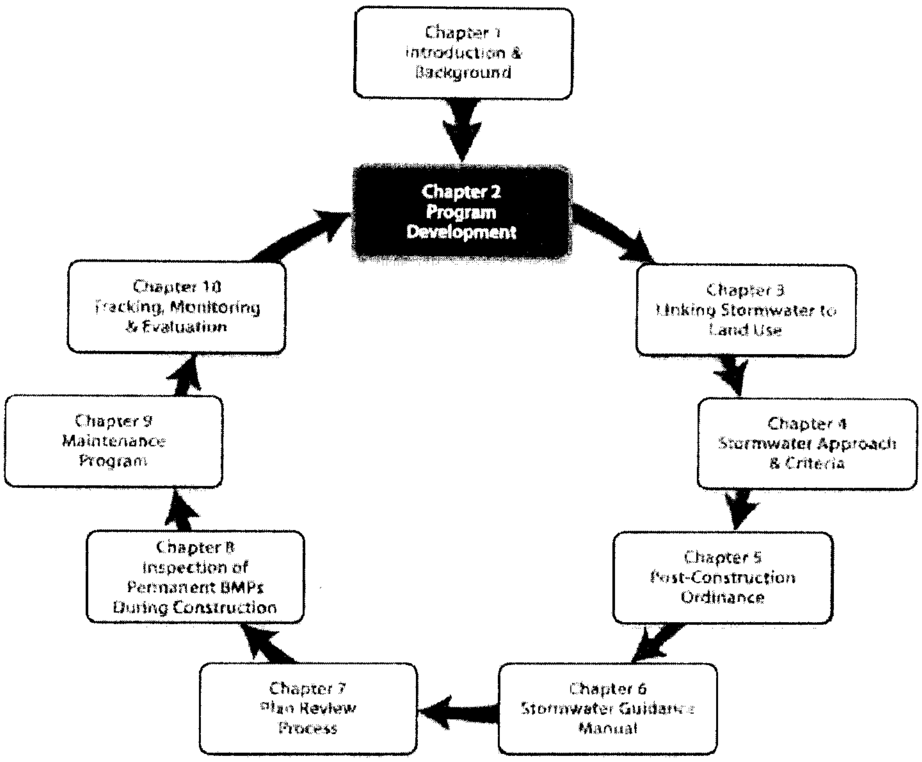
Current Trends	Recommended Actions
Post-Construction Program Development	
• Most Phase II MS4s operate program with $10K to $50K budget. • General fund constitutes most of budget. • Most programs have two or fewer staff working on post-construction stormwater.	Develop a post-construction program plan and budget to achieve a desired level of service. Seek a dedicated source of funding, such as a stormwater utility, for post-construction stormwater management. See **Chapter 2, Tools 1, 2.**
Linking Stormwater to Land Use Planning	
• For many programs, stormwater managers do not work closely with land use planners. • Stormwater is considered after major land use decisions have been made.	Build stronger link between stormwater program and the comprehensive plan and land use decisions. Use watersheds to organize stormwater and land use. See **Chapter 3, Tool 4.**
Stormwater Management Approach & Criteria	
• Most local programs address flooding, and an increasing number also deal with water quality and channel protection. • Fewer programs address groundwater recharge, reduction in overall runoff volume, or protection of sensitive receiving waters.	Develop a more holistic approach for post-construction stormwater management, including site design, source controls, stormwater practices, and protection of sensitive receiving waters. Distill a stormwater approach into criteria to be incorporated into ordinances and design guidance manuals. See **Chapter 4, Tool 3.**
Post-Construction Stormwater Ordinance	
• Approximately half of Phase II MS4s have adopted ordinance.	Adopt a post-construction stormwater ordinance in conjunction with or separate from ordinances for construction stormwater (erosion and sediment control) and illicit discharge detection and elimination. See **Chapter 5, Tool 3.**
Post-Construction Stormwater Guidance Manual	
• About 75% of states have some type of stormwater manual, but many manuals are out-of-date. • Most state and local manuals ***do not*** provide incentives or credits for low-impact development and innovative practices.	Develop local design guidance, referencing the most appropriate state, regional, or local manual for BMP design standards. If not already provided, build in credits for low-impact development and innovative BMPs. See **Chapter 6, Tools 5, 8.**
Stormwater Plan Review Process	
• Most programs lack adequate staff to fully review stormwater plans. • The average plan reviewer reviews 70 to 100 plans per year. • Stormwater is considered late in the development review process.	Develop adequate in-house staffing or consider outsourcing the review function. Use pre-submittal meetings and concept plans to ensure that stormwater is considered early in the site planning process. See **Chapter 7, Tool 6.**

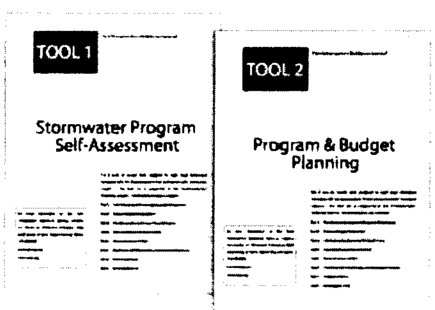
Table 1.7. Current Trends and Recommended Actions for Post-Construction Program *(continued)*

Current Trends	Recommended Actions
Inspection of Post-Construction BMPs During Installation	
• Most local programs conduct general construction inspections but might not focus on proper installation of post-construction BMPs. • Many post-construction BMPs are not installed correctly.	Inspect post-construction BMPs at critical installation milestones. Develop standard forms and checklists for inspection staff. Establish adequate enforcement procedures. See **Chapter 8, Tools 6, 7**.
Post-Construction Maintenance	
• Most Phase II MS4s do not have an established maintenance program. • Over half of programs do not use maintenance agreements. • Lack of maintenance is the single most important cause of failure for BMPs and stormwater programs.	Clearly assign maintenance responsibility through policies, maintenance agreements, and easements Develop a maintenance inspection and tracking program. Conduct outreach to responsible parties. See **Chapter 9, Tool 6**.
Program Tracking, Monitoring, and Evaluation	
• MS4s must establish measurable goals. • Although annual reports are submitted, many programs do not evaluate their programs or develop useful indicators of success.	Develop a combination of outcome-based and output-based minimum measures to gauge program success and develop annual reports. Use evaluations to set program priorities, build public support, and demonstrate compliance. Maintain proper documentation to prepare for a potential regulatory audit. See **Chapter 10**.

Download Tools at: *www.cwp.org/postconstruction*

Post-Construction Program Development—Assessing Your Program





Companion Tools for Chapter 2
Download Post-Construction Tools at:
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What's In This Chapter

- Assessing Your Watershed & Community
  - Geographic Information
  - Demographic Information
  - Water Resources Information
- Conducting a Post-Construction Program Self-Assessment
- Post-Construction Program Planning
  - Developing a Post-Construction Program Plan
  - Stormwater Program Funding Options

2.1. Assessing the Watershed and Community

The first step in developing a post-construction stormwater program is to collect several types of basic information about the watershed and community to help make informed decisions on priorities and pollutants of concern:

- Geographical
- Demographic/community
- Water quality

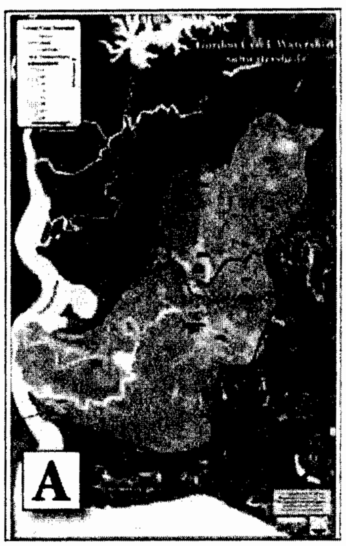
The list below is a starting point; additional information will likely be needed to address the unique issues in a particular community.

Geographical Information

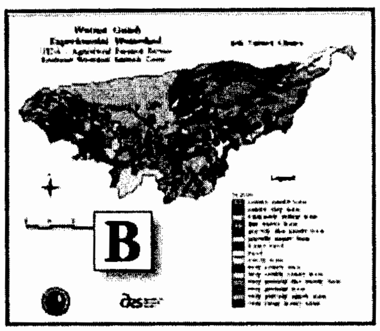
A locality's planning or public works departments will likely have many maps and other relevant geographical information. For example, soil, slope, geology, floodplain, and other natural hazard maps can identify areas where new development is most appropriate and where it should be avoided. Key information to collect includes:

- Maps
  - watersheds
  - floodplains
  - soils
  - land use
  - land cover
  - water resources (rivers, lakes, wetlands, etc.)
  - source water protection areas
  - roads
- Precipitation
- Areas prone to flooding

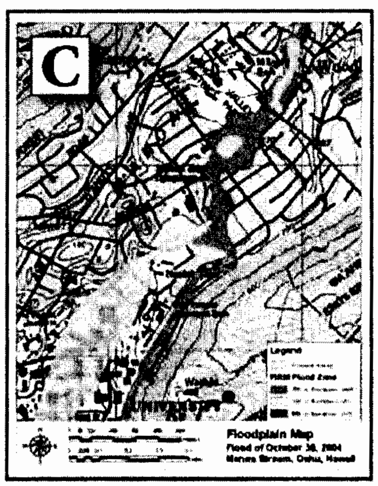
Several examples of these types of maps are shown in **Figure 2.1.**



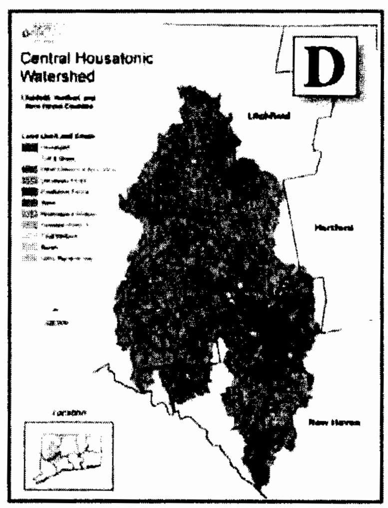
Source: Center for Watershed Protection www.cwp.org



Source: USDA, Agricultural Research Service http://www.tucson.ars.ag.gov/unit-gis/soils.html



Source: USDA, Natural Resource Conservation Service http://manoawatershed.ocrmhi.com/NRCS/index.php



Source: USDA, Natural Resource Conservation Service http://www.ct.nrcs.usda.gov/programs/CSP/landuse-landcover_housatonic.html

Figure 2.1. Example maps for post-construction program development: (A) watershed delineation, (B) soils, (C) floodplain delineation, (D) land use/land cover

Demographic and Community Information

It is important to understand the community's current population and land use in order to identify where growth is occurring and opportunities for redevelopment. In addition, the program should address anticipated future growth. Will it be primarily residential on the urban fringe, urban redevelopment, or another form? A stormwater manager should also analyze the past 1–3 years of recent construction projects to assess relative site size (very large mixed use projects vs. relatively small commercial/residential development), type (residential vs. commercial), and other issues. Key information to collect includes:

- Current population
- Anticipated population growth/change
- Current land use and zoning
- Proposed changes to land use
- Build-out analysis showing full development potential of existing zoning (see **Figure 2.2** for an example)
- Impervious cover
- Construction projects (number, type, etc.)
- Transportation, utility, and infrastructure plans

Water Quality Information

Water quality information will help identify the pollutants of concern and associated impaired waterbodies in the community and surrounding area. The post-construction program should be designed to reduce these pollutants of concern and specifically address impaired waterbodies. Key information to collect includes:

- Monitoring stations
- Groundwater: location of public wells, source water protection areas, etc.
- Existing water quality criteria and designated uses
- 303(d) impairments
- TMDLs
- Areas of local concern, such as eroded channels or water quality problem areas
- Other local waters in need of protection: high-value streams, lakes, and reservoirs

See **Figure 2.3** for examples of these types of maps.

After collecting information on the watershed and community, the next step is to conduct a program assessment of the post-construction program.

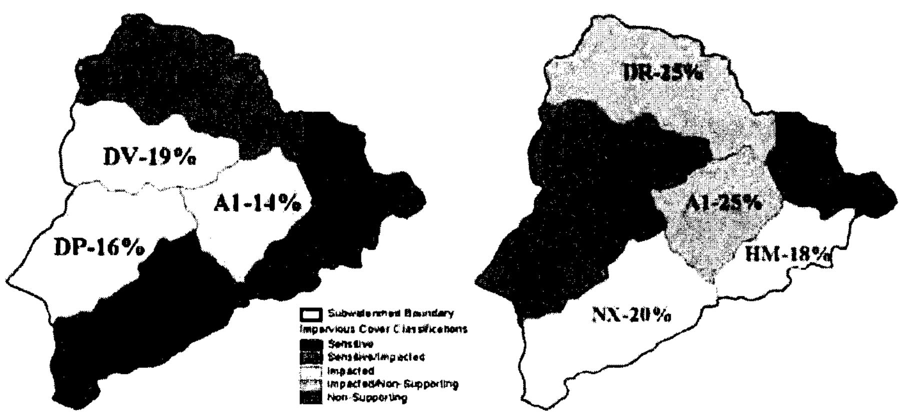


Figure 2.2. The map on the left shows existing impervious cover by watershed. The map on the right shows future impervious cover based on a build-out analysis using existing zoning codes in the Appoquinimink watershed (Source: Kitchell, 2003). **The impervious cover classifications are based on the Center for Watershed Protection's Impervious Cover Model** (CWP, 2003a).

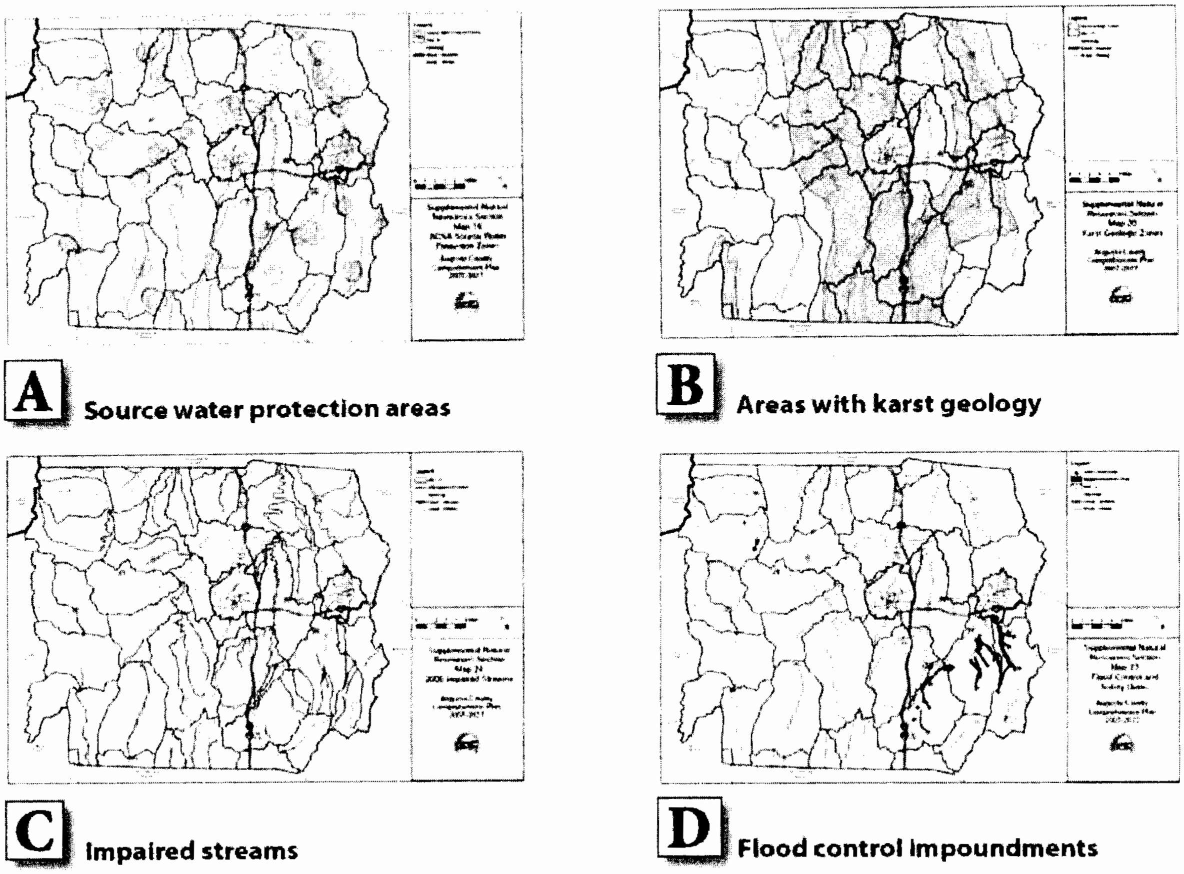


Figure 2.3. Examples of mapping of water resources information from Augusta County, Virginia (County of Augusta, 2007)

2.2. Conducting a Post-Construction Program Self-Assessment

Tool 1: Program Self-Assessment is a tool to help assess the existing status of a post-construction program and to identify key action items to address identified gaps. The program assessment asks questions to evaluate the program based on a continuum of program sophistication. The questions are divided into three subgroups, or types of communities:

Group A (Initiating the Program). These communities are initiating a stormwater management program, which might be a variation of an existing drainage and engineering program or an entirely new program. The elements in this subgroup should be accomplished by the end of the first permit term.

Group B (Enhancing the Program). Communities at this stage have a stormwater management program in place, but seek program enhancement to meet new stormwater rules or address growing stormwater issues. The elements in this group represent important enhancements that are necessary for an effective program.

Group C (Advancing the Program). Communities at this stage have more advanced stormwater programs that focus on a more refined match of BMPs to stormwater-related impacts, incorporating monitoring and innovative land and watershed planning techniques.

The Program Self-Assessment tool (Tool 1) includes instructions on how to complete the program assessment. For identified gaps, the stormwater manager is directed to specific chapters of this guide to help identify both short-term and long-term action items and measurable goals.

Before embarking on any self-assessment, however, it is important to scope out the state and NPDES requirements that apply to the post-construction program. Specific requirements for post-construction that are included in the MS4 permit should be addressed in the program self-assessment and action items.

Note that in addition to the Program Self-Assessment tool, the stormwater manager can also refer to EPA's *MS4 Program Evaluation Guidance* when conducting a post-construction assessment. Chapter 4.5 of the evaluation guide addresses post-construction programs. Although written primarily for EPA and state inspectors, the evaluation guide is also helpful for municipalities that wish to conduct a self-assessment of their stormwater program. A copy of the *MS4 Program Evaluation Guidance* is available at *www.epa.gov/npdes/stormwater.*

2.3. Post-Construction Program Planning

After collecting information on the community and watershed and conducting a program self-assessment, the stormwater manager will need to develop the post-construction program (or enhance an existing program). The first decision will be to articulate overall goals for post-construction stormwater runoff in the community.

Some example goals of the program could include:

- Meet regulatory requirements.
- Improve water quality and habitat conditions in the community's watersheds (rivers, streams, lakes, coastal waters, wetlands).
- Address flood risks and potential property damage.
- Improve the planning and development process.
- Support redevelopment within infill and enterprise zones.
- Integrate local plans and ordinances to ensure comprehensive watershed planning.
- Encourage site planning and stormwater techniques, such as low-impact development and green infrastructure practices, that best replicate pre-development hydrologic conditions.

For many communities, multiple goals guide program development. Deciding on the overall goal(s) for post-construction will help to design an effective program.

Developing The Post-construction Program Plan

The community and watershed assessment and post-construction program self-assessment (**Tool 1**) will identify the potential "gaps" in the post-construction program. Not all gaps need to be addressed right away. These gaps should be prioritized in relation to the resources needed and available to develop various program elements. A detailed post-construction program plan will help secure the resources and funding needed to implement the program.

A common program approach is to create a phased implementation plan. In this way, staff, resources, and budgets can be phased in over time—likely tied to the MS4 permit cycle.

Tables 2.1 through **2.3** provide a template for developing a comprehensive post-construction program plan. The three tables represent three different phases of program development:

- **Phase 1:** Program Development, Linking Stormwater to Land Use, and Adopting an Ordinance
- **Phase 2:** Developing or Adapting a Stormwater Guidance Manual and the Stormwater Plan Review Process
- **Phase 3:** Inspecting Permanent Stormwater BMPs During Construction, Developing a Maintenance and Inspection Program, and Tracking and Evaluating the Program

The tasks listed in each phase follow the chapters of this guidance manual, and the tables reference relevant manual sections and tools that can be used to assist with each subtask. These tables are meant to provide a template for a generic program, and each individual program should tailor the tasks and subtasks to its own program needs. (There is no "one size fits all" approach to stormwater program planning.)

Table 2.1. Phase 1 of a Comprehensive Program Plan

Phase I Task	Relevant Guide Section or Tool
1. Program Development	
1.a. Assess Watershed and Community	2.1
1.b. Conduct Program Self-Assessment	2.2, Tool 1
1.c. Develop Program Goals, Plan, and Budget	2.3, Tool 2
1.d. Develop and Implement Public Involvement Strategy	All Chapters
1.e. Hire Core Program Staff	2.3
2. Link Stormwater to Land Use	
2.a. Establish Links to Planning Department	3.7
2.b. Evaluate Existing Land Use Codes	3.6, Tool 4
2.c. Assess Integrated Stormwater/Land Use Tools	3.8
2.d. Adopt Land Use Policies That Support Water Quality Goals	Ch. 3
3. Adopt or Amend Stormwater Ordinance	
3.a. Develop Stormwater Approach and Relevant Criteria for the Community	Ch. 4
3.b. Identify MS4 Permit Requirements and Commitments	1.6, state general permits
3.c. Identify State, Regional, or National Model Ordinance	5.1, Tool 3
3.d. Decide Whether to Integrate Ordinance with Construction Stormwater and IDDE	5.2
3.e. Develop and Implement Stakeholder Participation Plan	5.5
3.f. Develop Draft Ordinance	Ch. 5, Tool 3
3.g. Estimate Plan Review, Inspection, and Maintenance Resource Burden	Chs. 7, 8, 9
3.h. Adopt Ordinance Through Public Process	Ch. 5

Table 2.2. Phase 2 of a Comprehensive Program Plan

Phase 2 Task	Relevant Guide Section or Tool
4. Develop and/or Utilize Relevant Stormwater Guidance Manual(s)	
4.a. Scope Out Design Guidance Task	6.4
4.b. Identify Local, State, or Regional Manual to use as Model or By Reference	6.11, Tool 5
4.c. Decide Whether to Integrate Manual with Construction Stormwater (erosion and sediment control manual)	1.2, 6.4
4.d. Develop and Implement Stakeholder Participation Plan	6.13
4.e. Develop/Reference Policy and Procedures Manual	6.5, Tool 5
4.f. Develop/Reference Technical Design Manual	6.6 – 6.10, Tool 5
4.g. Adopt the Manuals Through Public Process	6.12, 6.13
4.h. Provide Training on Use of Manuals	6.13
4.g. Update the Manuals at Least Every 5 Years	6.4, 6.12
5. Create or Enhance Stormwater Plan Review Process	
5.a. Scope Out Plan Review Process	7.3
5.b. Decide Whether to Do Review In-House or Outsource	7.5
5.c. Create Flowchart or Map Out Review Process	7.4
5.d. Create Forms, Applications, Instruction Materials, and Checklists for Applicants and Review Staff	7.4 – 7.5, Tool 6
5.e. Forecast Staff Needs and Acquire Staff	7.5, Tool 2
5.f. Provide Training for Review Staff and Design Consultants	7.5
5.g. Develop Web-based or Other Tracking System to Track Plans and Approvals	7.5, 10.6
5.h. Set Up Performance Bond Process, Forms, and Tracking System	Tool 7
5.i. Review Stormwater Plans	Ch. 7, Tool 6

Table 2.3. Phase 3 of a Comprehensive Program Plan

Phase 3 Task	Relevant Guide Section or Tool
6. Inspect Permanent Stormwater BMPs During Construction	
6.a. Scope Out Inspection Process	8.3
6.b. Decide Whether to Use In-House Inspectors or Contractors	8.5
6.c. Create Checklists, As-Built Certification Forms, and Other Forms Needed for Inspection	8.5, Tool 6
6.d. Forecast Staff Needs and Acquire Inspection Staff or Use Existing Staff	8.5, Tool 2
6.e. Provide Training for Inspectors and Contractors	8.5 – 8.6
6.f. Develop Web-based or Other Tracking System to Track Inspections and Enforcement Actions	10.6
6.g. Inspect BMPs During Construction	Ch. 8
7. Develop Maintenance and Inspection Program	
7.a. Scope Out Maintenance Program	9.3
7.b. Decide on Maintenance Approach and Make Level of Service Policy Decisions	9.3, 9.4
7.c. Decide Whether to Use In-House Inspectors or Contractors or Rely on Responsible Parties for Maintenance Inspections	9.4
7.d. Decide Whether to Use In-House Resources, Contractors, or Responsible Parties for Routine and Structural Maintenance Tasks and Repairs	9.4
7.e. Create Checklists, Inspection Forms, and Enforcement Tools	9.4, Tool 6
7.f. Forecast Staff and Equipment Needs and Acquire Resources	9.4, Tool 2
7.g. Create and Disseminate Outreach Materials for Responsible Parties	9.6
7.h. Develop Web-based GIS or Other Tracking System to Track Inspections and Enforcement Actions	10.6, 10.7
7.i. Inspect BMPs for Maintenance	9.5
7.j. Conduct Maintenance Tasks	9.5
8. Track, Evaluate, and Monitor the Program	
8.a. Scope Out Evaluation and Monitoring Tasks	10.3–10.5
8.b. Decide on Measurable Goals and Tracking Indicators	10.4–10.9
8.c. Develop Tracking and Reporting Tools to Track Key Indicators	Ch. 10
8.d. Write Annual Reports for Program Compliance and Other Program Reports and Documents	10.10
8.e. Maintain the Tracking System	Ch. 10

Tool 2: Program and Budget Planning Tool is a spreadsheet tool that enables the user to fill in the staffing needs and expenses, other program expenses, and potential revenue sources for each task and subtask identified in **Tables 2.1** through **2.3**. This is not a detailed budgeting tool, but it can help with program planning, goal setting, and phasing. This tool should be modified by stormwater managers to fit the needs and characteristics of their individual programs.

Another key program planning step is to ensure that staff assigned to the program have the right skills or can be trained to acquire them. Most local programs have engineers working in administrative and technical capacities (**CWP, 2006**). Other personnel skills that may be relevant for a post-construction program include:

- Land use and planning
- Budget planning and management
- Geographic information systems (GIS), global positioning systems (GPS), database
- Construction, inspections, facilities maintenance
- Capital project management
- Water quality and biology
- Hydrology
- Legal

It is also important for the post-construction program to have a lead department, division, or point of contact within the government or agency structure. Since post-construction often involves multiple staff functions and departments, the lead agency provides overall coordination and communication, and takes responsibility for meeting program milestones. The lead agency is often a public works department, but lead agencies may also be departments or divisions for community development, water and wastewater, environmental programs, stormwater utilities, or elected boards (**CWP, 2006**).

2.4. Stormwater Program Funding Options

Stormwater program managers have a wide range of funding sources to finance implementation of these programs, from general funds to dedicated sources like stormwater utilities. The program manager must assess each funding source to ensure it meets the stormwater program needs. The National Association of Flood and Stormwater Management Agencies (NAFSMA), under a grant from EPA, has developed *Guidance for Municipal Stormwater Funding*. This document helps municipalities address the procedural, legal, and financial considerations in selecting and developing stormwater financing approaches. The document is available at *www.nafsma.org*.

Candidate stormwater program funding sources include:

- Stormwater utilities
- General funds
- Clean Water State Revolving Fund (CWSRF) loans
- Fees
- Taxes
- Grants
- Debt financing
- Local improvement districts
- Developer participation
- Additional fees (impact, plan review and inspection, fee in lieu of on-site construction, system development fees/connection charges)

Each of these funding sources has advantages and disadvantages that have to be evaluated for compatibility with local needs. Furthermore, there are many other factors to examine when evaluating each funding source, such as state or local requirements, drainage infrastructure needs, and the political climate.

Stormwater Utilities

A common source of funding for stormwater management programs is the use of stormwater utilities and stormwater fees. Property owners are charged fees for the amount of stormwater produced on their property.

A stormwater utility is a mechanism to fund the cost of operations and capital projects directly related to the control and treatment of stormwater, including staffing, permitting, inspections, public education, watershed planning, and other program management costs. The fees are typically based on factors that influence stormwater runoff, such as amount of impervious surface, for a property and calculated using a predetermined classification, such as the equivalent residential unit (ERU), or another rate-setting methodology. In addition, the utility is administered and funded separately from the revenues in the general fund, which ensures a reliable source of funding for stormwater management.

Establishing a stormwater utility is a complex undertaking, and it requires careful planning and public outreach to be successful. The process usually involves conducting feasibility studies and system inventories, developing administrative and billing systems, mounting extensive public information campaigns, developing policies on credits and exemptions, adopting ordinances, and implementing the utility.

General Fund

The traditional source of funding for stormwater management programs is the jurisdiction's general fund. These monies are usually generated from a variety of sources, including taxes (e.g., income, sales and property taxes), exactions (e.g., franchise fees on utilities), and federal/state revenue sharing, and are simply appropriated for specific purposes, including stormwater management, through the normal budget process.

In some cases, the revenues appropriated by the general fund are sufficient to provide financial support for the entire stormwater program. However, this source of revenue is used to fund many other programs, and revenues are variable and unpredictable. Elected officials must determine the relative priority of stormwater management versus numerous other needs and services. The unpredictable, political, and limited nature of the general fund has pushed many stormwater managers to pursue the stormwater utility approach.

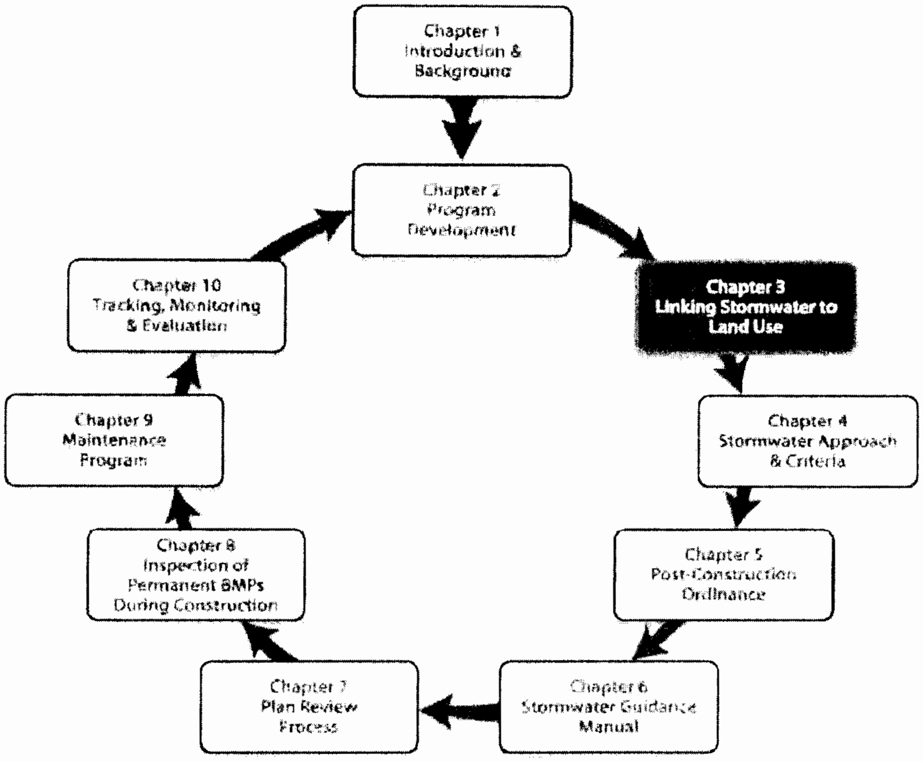
Other Sources of Funding

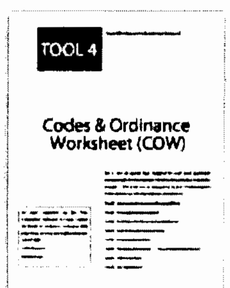
Other funding sources are one-time grants (federal, state, or local), loans or bonds, state revolving funds, and additional fees that can cover costs of erosion and sediment control, structural stormwater management, upgrades or improvements to the program, operation and maintenance of sewers, acquisition of environmentally sensitive land, and other environmental initiatives.

Municipalities also have the option of using additional funding strategies, such as impact fees, plan review and inspection fees, fee-in-lieu payments, and system development fees/connection charges to fund the stormwater management program. Impact fees transfer the cost of roads, sewers, stormwater treatment, and other facilities needed for development directly to developers and can relieve financial pressures on the budget. In addition, plan review and inspection fees can be charged to cover the costs of reviewing development plans, inspecting BMPs, and ensuring that development plans are properly implemented. Another funding strategy is to develop a fee-in-lieu program whereby developers pay a fee to the local program in lieu of partial or full on-site compliance with BMP requirements. The local program, in turn, uses the funds to conduct stormwater and watershed projects, such as stormwater retrofits, stream and wetland restoration, and regional projects.

Chapter 3

Land Use Planning as the First BMP: Linking Stormwater to Land Use





Companion Tools for Chapter 3
Download Post-Construction Tools at:
www.cwp.org/postconstruction

What's In This Chapter

- Why stormwater managers should engage in land use decisions
- Planning at different scales
  - Regional
  - District or neighborhood
  - Site level
- A process for integrating stormwater and land use planning
  - Understand the role of impervious cover and other watershed factors
  - Examine and evaluate land use codes
  - Develop relationships between stormwater managers, land use planners, and other officials
  - Use watersheds are organizing units
- Considering climate change in the stormwater/land use program

3.1. Introduction

Increasingly, communities are looking for ways to maximize the opportunities and benefits associated with growth while minimizing and managing the environmental impacts of development. Balancing these priorities is playing out in planning commission meetings, boardrooms, mayors' offices, and public meetings throughout the United States. Stormwater managers can, and should, be central players in such conversations. Where and how development occurs can dramatically affect a community's watersheds, infrastructure, and water supplies. Effectively engaging in these discussions can help communities better balance development decisions with environmental protection.

The barrier, however, is where and how to engage in development decisions. Traditionally, the practice of stormwater management has been limited to site-level approaches. However, stormwater management is evolving beyond engineered approaches applied at the site level to an approach that looks at managing stormwater at the regional, district/neighborhood, and site scales.

By looking at stormwater management at various scales, stormwater managers can influence the development debate in a number of ways. For example, they can, and should, be active in helping a community craft policies and incentives to direct development to already disturbed or degraded land. Redeveloping a parking lot, abandoned mall, or already degraded site allows a community to enjoy the benefits of growth without increasing net runoff. In this way, engaging in growth and development discussions can be considered the "first stormwater best management practice."

The purpose of this chapter is to highlight opportunities where stormwater managers can engage in broader growth and development decisions. Every community is unique and has it own vision of its character. Certainly, a development discussion concerning redevelopment of an aging downtown area will cover issues substantially different from those of a rural town struggling to maintain its character. Both communities, however, will discuss policies and regulations, such as road and street width, building setbacks, parking requirements, and open space requirements, that can have a direct impact on stormwater runoff.

This chapter seeks to highlight those development-related policies and regulations and describe how stormwater managers might effectively engage and influence land use decisions.

3.2. Why Should Stormwater Managers Engage in Land Use Decisions?

Many stormwater managers do not see engaging in land use decisions as part of their job. Indeed, the past few decades of stormwater management have focused on using control and treatment strategies that are largely hard-infrastructure-engineered, end-of-pipe, and site-focused practices concerned primarily with peak flow rate and suspended solids concentration control.

Where and how communities grow affects water quality. The collective experience of communities across the United States demonstrates that looking only at site-level practices will not repair damaged waterbodies and will likely put more streams on impaired lists over time.

Indeed, factors at the site, district/neighborhood, and regional scales can drive the creation of unnecessary impervious cover and other land cover conditions that produce excessive runoff. These factors are embedded in a community's land use codes and policies. A comprehensive approach to stormwater management should therefore include an examination of a locality's land development regulations, policies, and ordinances to better align with water quality goals.

For example, a subdivision ordinance dictates minimum houses per acre, street width, and the distance a house is set back from the road. All of these measures create impervious surface. It is for the municipality to determine whether the creation of this impervious surface and the generation of the associated runoff are appropriate. In this way, the municipality aligns its subdivision regulations with its stormwater goals.

Table 3.1 lists common land use development regulations, codes, and policies that could be reviewed for consistency with stormwater goals. These documents are also needed to complete the "Codes and Ordinance Worksheet," which is a tool to assist with the systematic review of codes and policies for consistency with model development principles (see Tool 4).

A comprehensive approach to stormwater management involves developing stormwater management practices that can be applied at the regional, district/neighborhood, and site scales. It also involves looking at where and how development occurs within the community. This is best done by examining common land development regulations and policies that dictate the location, quantity or density, and design of development.

3.3. Planning at Different Scales

Decisions about where and how to grow are the first, and perhaps most important, development decisions related to water quality. A comprehensive stormwater management approach supports an interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while also providing recreational opportunities and wildlife habitat. These open spaces must be balanced with areas where growth and development are appropriate. Traditionally, stormwater managers have engaged at the development site level by restricting development within the riparian buffer, wetlands, or other critical natural features. However, engaging in this issue at the district/neighborhood scale or regional scale can have a greater water quality benefit

A 2006 EPA study found that, conceptually, higher-density development can be more protective of regional water quality than lower-density scenarios because less stormwater and associated pollutants are produced on a per-unit basis (USEPA, 2006a). Figure 3.1 illustrates how dense developments, although they have a high site-level impervious cover, can result in a lower watershed impervious cover compared to a scenario where development is equally spread out across the watershed. For example, in scenario C development is directed to 1/8-acre lots in a small

Table 3.1. Common Land Use Development Regulations, Codes, and Policies That Can Drive Impervious Cover

- ***Zoning ordinance*** specifies the type of land uses and intensity of those uses allowed on any given parcel. A zoning ordinance can dictate single-use, low-density zoning, which spreads development out throughout the watershed, creating excess impervious cover.
- ***Subdivision codes*** or ordinances specify specific development elements for a parcel: housing footprint minimums, distance from the house to the road, the width of the road, street configuration, open space requirements, and lot size—all of which can lead to excess impervious cover.
- ***Street standards or road design guidelines*** dictate the width of the road for expected traffic, turning radius, the distance for other roads to connect to each other, and intersection design requirements. Road widths, particularly in new neighborhood developments, tend to be too wide, creating considerable impervious cover.
- ***Parking requirements*** generally set the minimum, not maximum, number of parking spaces required for retail and office parking. Setting minimums leads to parking lots designed for peak demand periods, which can create acres of unused pavement during the rest of the year.
- ***Minimum setback requirements*** can spread development out by leading to longer driveways and larger lots. Establishing maximum setback lines for both residential and retail development brings buildings closer to the street, reducing the impervious cover associated with long driveways, walkways, and parking lots.
- ***Site coverage limits*** can disperse the development footprint and make each parcel farther from its neighbor, leading to more streets and roads and thereby increasing total impervious cover throughout the watershed.
- ***Height limitations*** limit the number of floors for any building. Limiting height can spread development out if square footage cannot be met by vertical density.

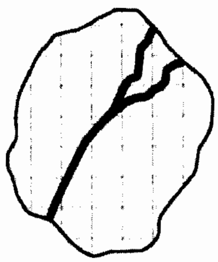
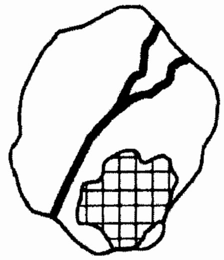
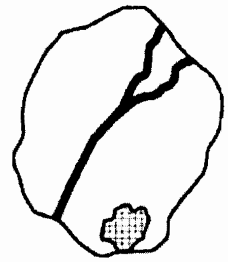
Scenario A	Scenario B	Scenario C
		
10,000 houses built on 10,000 acres produce:	10,000 houses built on 2,500 acres produce:	10,000 houses built on 1,250 acres produce:
10,000 acres x 1 house x 18,700 ft^3/yr of runoff =	2,500 acres x 4 houses x 6,200 ft^3/yr of runoff =	1,250 acres x 8 houses x 4,950 ft^3/yr of runoff =
187 million ft^3/yr of stormwater runoff	**62 million ft^3/yr of stormwater runoff**	**49.5 million ft^3/yr of stormwater runoff**
Site: 20% impervious cover	**Site: 38% impervious cover**	**Site: 65% impervious cover**
Watershed: 20% impervious cover	**Watershed: 9.5% impervious cover**	**Watershed: 8.1% impervious cover**

Figure 3.1. Watershed impervious cover at different development densities (Source: U.S. EPA, 2006a)

portion of the watershed, resulting in 65% impervious cover for the development site but only 8% impervious cover for the entire watershed. If an equivalent number of development units are spread out over the entire watershed (scenario A), the development has a lower impervious cover but the watershed has a much higher impervious cover, 20%.

The following sections describe potential approaches a stormwater manager can take to address stormwater at the regional, district/neighborhood, or site scale.

Regional Stormwater Management Approaches

Stormwater managers should begin to address stormwater at a regional scale by doing the following:

Preserving open space and critical ecological features. Preserving open space is critical to maintaining water quality at the regional level. Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. Preserving ecologically important land, such as wetlands, buffer zones, riparian corridors, and floodplains, is critical for regional water quality.

Encouraging development in already-degraded areas. Perhaps the biggest opportunity for any stormwater manager is to work with local governments to develop a range of policies and incentives to direct development to already degraded areas. Communities can enjoy a significant reduction in regional runoff if they take advantage of underused properties, such as infill, brownfield, or greyfield sites (sites in abandoned or underutilized commercial areas) (**Congress for New Urbanism, 2001**). Redeveloping already degraded sites such as abandoned shopping centers or underutilized parking lots rather than paving greenfield sites for new development can dramatically reduce total impervious area and water quality impacts.

Using land efficiently. Using land efficiently reduces and better manages stormwater runoff by putting development where it is most appropriate and reducing total impervious area. For example, by directing and concentrating new development in areas targeted for growth, communities can reduce or remove development pressure on undeveloped parcels and protect sensitive natural lands and recharge areas.

District or Neighborhood Stormwater Management Approaches

Stormwater at the district or neighborhood scale can be addressed through approaches, like the following:

Mixed use and transit-oriented development. Mixing land uses can have direct effects on reducing runoff because mixed-use developments have the potential to use surface parking lots and transportation infrastructure more efficiently, requiring less pavement. Transit-oriented development can help protect water quality by reducing (1) land consumption due to smaller site footprints, (2) the number of parking spaces, and (3) average vehicle miles traveled, which in turn reduces atmospheric sources of pollution that can end up in receiving waters. Because higher-density development is clustered around transit stops, the need for developing land elsewhere in a region can be reduced (if the proper policies and controls are in place).

Green streets. The green streets concept is a streetscape design with multiple functions that integrates the "natural" and the "manmade." Green street streetscapes facilitate natural infiltration wherever possible and therefore have less impervious surface such as concrete and asphalt. They allow for greater use of vegetation and other attractive materials, such as crushed stone and pavers, which can help to create an identifiable community character.

Parking requirements. Another strategy to reduce impervious cover is to assess parking requirements, particularly those for parking lots. Better balancing parking demand and supply could help remove some of the excess spaces. Some communities have found that "park once," shared parking strategies, and allowing on-street parking can help balance parking supply and demand. In 2006 EPA published *Parking Spaces/Community Places: Finding the Balance Through Smart Growth Solutions*. This document highlights approaches that balance parking with broader community goals (**USEPA, 2006b**).

Open-space amenities. In recent decades Americans have demonstrated their preference for living near or adjacent to parks or other open-space areas by their willingness to pay a premium for housing near these amenities (**Trust for Public Land, 1999**). Nationwide, easy access to parks and open space has become a measure of community health. These district/neighborhood open spaces can also serve critical stormwater functions, such as providing buffer areas for stormwater quality or areas to reduce stormwater flooding.

Site-level Stormwater Management Approaches

After minimizing runoff at the regional and district/neighborhood scales, stormwater management finally turns to the site scale. Many of the remaining chapters in this guide focus on site-level stormwater strategies. For instance, **Chapter 4** includes a recommended stormwater management approach that is largely relevant to the site scale.

Smart Growth Approaches to Stormwater Management

Table 3.2 lists various EPA publications about the relationship between planning and water quality that are relevant to water resources and stormwater management. It should also be noted that EPA's *National Menu of Stormwater Best Management Practices* lists many Smart Growth and site design techniques among post-construction best management practices (BMPs; see **Table 3.3**). EPA encourages a mix of structural, nonstructural, and planning techniques to address the post-construction minimum measure.

The remainder of this chapter introduces a process for integrating stormwater with land use planning. In other words, it outlines how a stormwater program can consider land use as the "first BMP" by integrating ideas and techniques that engage the stormwater manager in land use issues.

Table 3.2. EPA Publications Related to Water Resources and Stormwater
Note: See *www.epa.gov/smartgrowth* for more information.

Using Smart Growth Techniques as Stormwater Best Management Practices, EPA 231-B-05-002. December 2005.
www.epa.gov/smartgrowth/stormwater.htm
A guidance document that reviews nine common smart growth techniques and examines how they can be used to prevent or manage stormwater runoff.

Protecting Water Resources with Higher-Density Development, EPA 231-R-06-001. January 2006.
www.epa.gov/smartgrowth/water_density.htm
A guidance document that helps communities better understand the impacts of higher- and lower-density development on water resources. The findings indicate that low-density development might not always be the preferred strategy for protecting water resources.

Parking Spaces/Community Places, EPA 231-K-06-001. January 2006.
http://www.epa.gov/smartgrowth/parking.htm
A guidance document that helps communities explore new, flexible parking policies that can encourage growth and balance parking needs with their other goals.

Protecting Water Resources with Smart Growth, EPA 231-R-04-002. May 2004.
www.epa.gov/smartgrowth/water_resource.htm
A guidance document intended for audiences that are already familiar with smart growth concepts and want specific ideas on how smart growth techniques can be used to protect water resources. Suggests 75 policies that communities can use to grow in the way that they want to while protecting their water quality.

Stormwater Guidelines for Green, Dense Redevelopment, December 2005.
www.epa.gov/smartgrowth/emeryville.htm
A City of Emeryville, California, grant product that is geared specifically to developers and designers. These guidelines offer ways to meet requirements to treat stormwater from development projects.

Solving Environmental Problems through Collaboration: A Case Study of the New York City Watershed Partnership, EPA 231-F-06-005. June 2006.
www.epa.gov/innovation/collaboration
A fact sheet that provides a summary of the partnership, which works closely with government and nongovernmental partners to protect the drinking water supply of 9 million people while promoting economic viability and preserving the social character of the communities in the upstate watershed.

Growth and Water Resources, EPA 842-F-02-008. September 2005.
www.epa.gov/smartgrowth/pdf/growthwater.pdf
A fact sheet that explains how land use affects water resources and offers resources and tools for communities.

Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies, EPA 230-R-06-001. January 2006.
www.epa.gov/smartgrowth/water_efficiency.htm
A guidance document that focuses on the relationships among development patterns, water use, and the cost of water delivery and includes policy options for states, localities, and utilities that directly reduce the cost and demand for water while indirectly promoting smarter growth.

Smart Growth for Clean Water. National Association of Local Government Environmental Professionals, Trust for Public Land, ERG. 2003.
www.resourcesaver.com/file/toolmanager/CustomO93C337F42157.pdf
A grant product that offers ideas for using smart growth to advance clean water goals based on the experiences of communities across the nation.

Potential Roles for Clean Water State Revolving Fund Programs in Smart Growth Initiatives, EPA 832-R-00-010. October 2000.
www.epa.gov/owm/cwfinance/cwsrf/factsheets.htm
A guidance document that describes options for states to use their Clean Water State Revolving Funds to support more environmentally sound growth and development.

Table 3.3. EPA's *National Menu of Stormwater Best Management Practices*: Selected Post-Construction BMPs Consistent with Smart Growth and Site Design Strategies
www.epa.gov/npdes/menuofbmps

- Conservation Easements
- Development Districts
- Eliminating Curbs and Gutters
- Green Parking
- Green Roofs
- Infrastructure Planning
- Low-Impact Development and Green Design Strategies
- Narrower Residential Streets
- Open-Space Design
- Protection of Natural Features
- Redevelopment
- Riparian/Forested Buffer
- Street Design and Patterns
- Urban Forestry

3.4. A Process for Integrating Stormwater and Land Use

The following four steps are recommended to begin integrating stormwater with land use:

1. Understand the role of impervious cover and other watershed factors at the regional, district/neighborhood, and site scales.
2. Examine and evaluate land use codes for drivers of excess impervious cover and land disturbance.
3. Develop relationships between stormwater managers, land use planners, and other officials.
4. Use watersheds as organizing units for the linked stormwater/land use program.

The following sections discuss each step in more detail.

3.5. Step 1: Understand the Role of Impervious Cover and Other Watershed Factors at the Regional, District/Neighborhood, and Site Scale

Impervious cover has become one of the most important indicators of overall watershed health because it is relatively easy to measure and the correlations with stream health have been documented for small watersheds draining first- to third-order streams (e.g., 2 to 20 square miles) (**CWP, 2003a; Schueler et al., in review**). Thus, controlling overall impervious cover at the watershed or community level is one of the chief strategies currently employed to limit stormwater impacts.

Though development in various watersheds is highly varied, research finds that indicators of stream health decline with increasing impervious cover (**CWP, 2003a; Schueler et al., in review**). **Figure 3.2** presents a conceptual model that expresses the impervious cover/stream health relationship as a "cone" that is widest

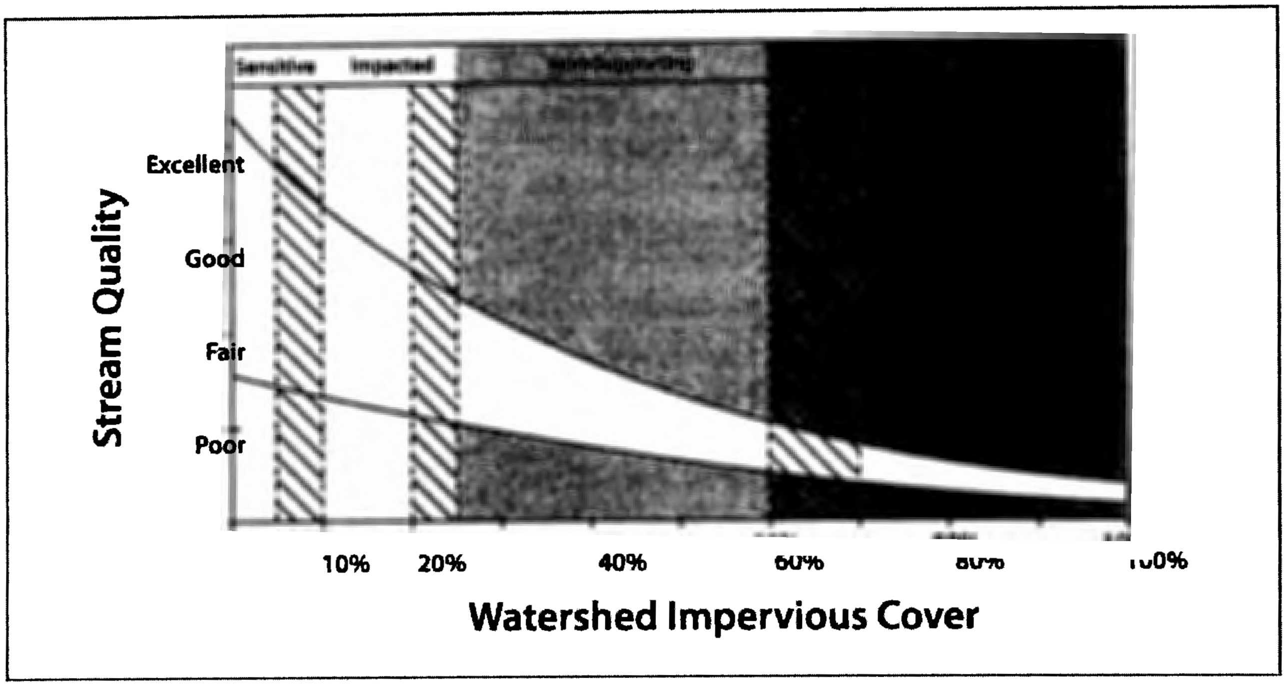


Figure 3.2. Conceptual model illustrating the relationship between impervious cover and stream health. (Source: Schueler et al., in review)

at lower levels of impervious cover and progressively narrows at higher levels of impervious cover (**Schueler et al., in review**).

The cone width is greatest at lower levels of impervious cover (e.g., less than 10 percent), reflecting the wide variability in stream response found in less-urban watersheds. The expected quality of streams in this lower range of impervious cover is generally influenced more by other watershed metrics, such as forest cover, road density, extent of riparian vegetative cover, and cropping practices (**CWP, 2003a**). At higher levels of impervious cover, the cone is narrower because most streams in highly impervious, urban watersheds exhibit fair or poor stream health conditions (i.e., the correlation between impervious cover and stream health is stronger) (**Schueler et al., in review**).

The model also illustrates how impervious cover can be used to classify and manage subwatersheds according to four categories of stream health: sensitive, impacted, non-supporting, and urban drainage. The transitions between management categories are shown as ranges (e.g., 5%–10%, 20%–25%, 60%–70%) as opposed to sharply defined thresholds, since most regions show a generally continuous but variable gradient of stream degradation as impervious cover increases (**Schueler et al., in review**).

Stormwater and watershed managers should define their own ranges based on actual monitoring data for their region, the stream indicators of greatest concern, and the predominant predevelopment regional land cover (e.g., crops or forest). This model can be used to make initial predictions about stream health based on impervious cover, coupled with supplemental field monitoring to confirm or refine the diagnosis. In addition, impervious cover should not be the sole metric used to predict stream quality, especially at the lower ends of subwatershed impervious cover.

Other watershed metrics—such as watershed forest cover, riparian forest cover, agricultural land, wetlands, road crossings, and impoundments—can strongly influence watershed and stream health. Therefore, it is important to understand the relationship between these factors and stream health, and to develop strategies to manage them (e.g., adopting regulations that require conservation of forest buffers). Nevertheless, impervious cover remains an important watershed metric for stormwater managers to track and manage.

The factors that drive the proliferation of impervious cover within watersheds are often embedded within complex land development codes and standards. These same codes and standards can also influence other land cover metrics that affect watershed health, such as the amount and location of forest cover present in the watershed. Before undertaking a large-scale program review, it is helpful to understand the factors that shape impervious cover and other land cover types in the built environment.

As discussed earlier in this chapter, these factors operate at three different scales: (1) the region, (2) the district or neighborhood, and (3) the site. The actual codes and policies that operate at these three scales are examined in more detail in the following section.

3.6. Step 2: Examine and Evaluate Land Use Codes for Drivers of Excess Impervious Cover and Land Disturbance

As explained at the beginning of this chapter, there are factors at the site, district/neighborhood, and regional scales that are hidden drivers of impervious cover. The next step in the process of linking stormwater to land use planning is to pry into these codes and policies to see if they can be made more consistent with overall stormwater management goals. For instance, if the local zoning code requires wide streets with curbs and gutters, perhaps alternative designs with less pavement and more vegetation should be considered.

Table 3.4 lists the most common local development codes and documents that should be reviewed for consistency with stormwater goals. These documents are also needed to complete the "Codes and Ordinance Worksheet," which is a tool to assist with the systematic review of codes and policies for consistency with Better Site Design model development principles (see **Tool 4**).

Table 3.4. Key Local Documents to Review for Consistency with Stormwater Goals

- Zoning ordinance
- Subdivision codes
- Subarea or district master plans
- Street standards or road design manual
- Parking requirements
- Building and fire regulations/standards
- Stormwater management or drainage criteria
- Buffer or floodplain regulations
- Environmental regulations
- Tree protection or landscaping ordinance
- Erosion and sediment control ordinances
- Public fire defense master plans
- Grading ordinance

The following sections highlight some of the most common local code and policy issues that might conflict with good stormwater management. **Chapter 5** goes into more detail on developing appropriate stormwater codes and how to identify inconsistencies with existing regulations.

Code and Policy Issues That Drive Impervious Cover at the SITE SCALE

Many codes and policies at the site scale can inadvertently increase impervious cover. For example, *setback requirements* can lead to inefficient use of land by spreading development out and creating the need for longer driveways. *Height limits* can spread development out if square footage cannot be met by going up. Site coverage limits can disperse the development footprint and make each parcel farther from its neighbor, leading to more public infrastructure. Many different *parking requirements*, including the following, increase impervious cover:

- ***Parking standards.*** Most land development codes contain detailed specifications on parking requirements that are based on bulletins from the Institute of Transportation Engineers (ITE). The bulletins, which are updated regularly, estimate parking demand for various uses, which are then translated into site plan requirements. These requirements are often listed as minimums. Often the number of spaces is driven by a few high-volume shopping days each year, and the studies used to estimate parking demand are often carried out in areas where the automobile is the only mode of transportation considered. In addition, the extra spaces trigger additional imperviousness in the form of drive aisles, access lanes, and turn lanes from roadways.

- ***Parking requirements for redevelopment.*** Older buildings might have fewer spaces than required in updated parking codes. Redevelopment of an older building often triggers the more recent requirements. Where the older buildings are on small lots, parking minimum requirements can be a barrier to redevelopment.
- ***Financial requirements.*** Developers who seek financing often meet resistance to the idea of supplying fewer spaces from lenders, who equate extra parking spaces with lower financial risk.
- ***District-wide and shared parking.*** Perhaps one of the larger, often unexplored drivers of excess parking is the practice of assessing parking needs one development project at a time. This precludes the ability to arrange efficient parking supply among users.
- ***Use of streets.*** Some localities are discovering on-street spaces as excess capacity for meeting parking needs. The imperviousness is already there, and thus using streets can alleviate the need to construct more parking.

Code and Policy Issues That Drive Impervious Cover at the DISTRICT/NEIHBORHOOD SCALE

At the district or neighborhood scale, impervious cover can be driven by policies such as separated use policies, street design practices, and subdivision design. These drivers are further discussed below:

- ***Separated uses.*** The zoning convention of assembling development projects consisting of a single use (e.g., all housing in subdivisions or all commercial uses in office parks) has been widely studied for impacts on travel, transportation, and congestion. According to the Bureau of Transportation Statistics, Americans average four trips per day, totaling on average 40 miles of travel, mostly in a personal vehicle. These trips, to commute, shop, and recreate, are used as input to models for parking requirements, travel demand, and the like. For stormwater, these separated uses result in an increased need for transportation infrastructure, and its related imperviousness.
- ***Street design.*** In the 1950s and 1960s, roadway design practices began to favor a less networked, "hierarchical" street design. Within housing subdivisions, the individual, smaller streets feed into collector roads, which then lead, often through only one intersection, to arterials. This type of system concentrates traffic onto fewer roads, which increases the pressure to build large public roads or widen existing roads originally planned for rural traffic patterns.
- ***Street and roadway widths.*** Early roadway standards established minimum lane widths for rural highways. Wider lanes were needed to provide the sight clearance and maneuvering space needed for higher speeds. Over time, these widths were integrated into local street standards.

  Roadway imperviousness is not limited to lane widths. The size of turning and queuing lanes is also governed by standard formulas. The wider street standards brought with them higher design speeds. These speeds, in turn, dictate the size of intersections and curb radii, which are referred to as "intersection geometry" in transportation handbooks. For a full discussion of street geometry and its relationship to site development, see *http://safety.fhwa.dot.gov/ped_bike/univcourse/swless06.htm.*
- ***Subdivision design.*** Residential subdivision codes are the primary example of a district code. Subdivision codes (which are typically supported by enabling legislation at the state level) include requirements for roadways, drainage, open space, building alignments, lot sizes, and many other features.

  Planners have been working on improvements to subdivision codes to eliminate some of the commonly noted drawbacks, such as excessive site clearance and the lack of mixed use. Planned unit developments (PUDs) often add a mixed-use component to subdivisions, while conservation subdivisions strive to lessen environmental impacts by clustering home sites and preserving open space within residential areas. Nevertheless, conventional subdivision design still dominates site planning and residential construction. A 2004 study on subdivisions found street, driveway, and site imperviousness composed up to 50% of the total development site (**Local Government Commission, 2004**).

Code and Policy Issues That Drive Impervious Cover at the REGIONAL SCALE

Impervious cover drivers at the regional scale can include lack of coordination between units of government, state standards, and transportation requirements at the state/federal level. These drivers are further discussed below:

- ***Lack of regional governance structures.*** Jurisdictional boundaries often have the effect of spurring competition, not cooperation. This competition for tax base often leads to dispersed growth. With stormwater, the permitted agency is in many cases a relatively small unit of government, such as a township or village. Decision-making at this level is rarely coordinated at the watershed scale.
- ***Codes and standards at the state level.*** States often set requirements that result in a larger development footprint. For example, school siting standards often require at least 20, 50, or even 100 acres for new schools. School districts often find that the only parcels of this size are in undeveloped areas. School construction then generates new development interest in the surrounding area.
- ***Split responsibility for transportation.*** States are usually responsible for Interstates, state highways, and sometimes local roads. Localities might be responsible for local roads and district/neighborhood streets. Often, it is difficult to coordinate transportation and land use planning among the different agencies. Decisions to expand or improve transportation systems at the state level can run counter to local land use priorities.

3.7. Step 3: Develop Relationships Between Stormwater Managers, Land Use Planners, and Other Officials

If land use is to effectively become the "first BMP" for a stormwater program, it is imperative that stormwater managers form closer working relationships with

- Land use planners
- Transportation planners
- School officials
- Parks and recreation staff
- Public facility engineers
- Emergency management officials
- Other local officials

In many jurisdictions, the stormwater managers might have limited interaction with other municipal staff who have an impact on the stormwater program. The stormwater manager is likely housed within a public works or engineering department. If he or she is engaged in site plan review, the main focus is at the site scale. The stormwater manager might also work on capital projects involving drainage or other infrastructure.

Meanwhile, land use planners are customarily located in planning and community development departments. They engage most closely with zoning issues, such as setbacks and parking requirements, and they are also responsible for developing and revising the community's land use and comprehensive plans. They might also be involved in community-wide issues like economic development, housing, and transportation.

A more effective approach would promote integration across departments and professions, with the comprehensive plan being one of the primary mechanisms for working together. This integration would encourage more involvement on stormwater issues early in the planning process. For example, stormwater managers could be involved in the following areas:

- ***Land use.*** Stormwater managers might be called upon to estimate the stormwater and flooding impacts of growth alternatives, to point out opportunities to use low-impact and redevelopment alternatives, and to offer suggestions on which areas of land might be best suited for handling stormwater. In rural and suburbanizing areas, stormwater managers might be asked to assess various build-out scenarios for future growth and watershed management.

- ***Redevelopment.*** Because redevelopment is commonly more complex than new development, many comprehensive plans attempt to reduce barriers to redevelopment such as the limited space for stormwater BMPs at many urban redevelopment sites. Stormwater departments might be asked to design district-wide or shared facilities and/or tailored site-level BMPs suited to ultra-urban settings.
- ***Transportation.*** Transportation plans can be coordinated with stormwater by considering linear transportation projects within the context of watersheds and surrounding development. Sometimes, stormwater strategies can serve both transportation and development needs, and transportation projects might also be able to provide land or mitigation funds for protected or restored natural resources areas. Stormwater managers might also want to engage transportation engineers on innovative stormwater techniques that can be incorporated into the road section or right-of-way.
- ***Economic development.*** The funding of stormwater and flood control projects might provide a strong economic incentive for development and redevelopment decisions. Stormwater managers might be asked to work with economic development staff to see where improvements meet water and business development needs.
- ***Parks and open space.*** Stormwater managers might be asked to identify parcels with high value for stormwater management. In urban areas, these parcels might need to serve several purposes, so stormwater programs could be called upon to work with parks, recreation, habitat, or water supply organizations.

Table 3.5 describes several mechanisms to build better relationships between stormwater managers, land use planners, and other local officials.

Table 3.5. Tips for Building Relationships Between Stormwater Managers, Land Use Planners, and Other Local Officials

Include both land use planners and stormwater managers in pre-concept and/or pre-application meetings for potential development projects.
Use local government sites (e.g., schools, regional parks, office buildings, public works yards) as demonstration sites for innovative stormwater management. Form a team that includes land use planners, stormwater managers, parks and school officials, and others to work out the details.
Include stormwater managers in the comprehensive plan process so that overall watershed and stormwater goals can be incorporated.
Make sure that both land use planners and stormwater managers are involved in utility and transportation master planning.
Involve stormwater managers in economic development planning, especially for enterprise zones, Main Street projects, and other projects that involve infill and redevelopment. Encourage stormwater managers to develop efficient watershed-based solutions for these plans.
Develop cross-training and joint activities that allow land use planners, stormwater managers, and transportation, utility, and capital project planners to explore how various land use/stormwater processes can be better integrated.
For staff training, bring in speakers who are knowledgeable about stormwater management. Alternatively, encourage land use planners, stormwater managers, and other local officials to attend training on this topic as a team.

3.8. Step 4: Use Watersheds as Organizing Units for the Linked Stormwater/Land Use Program

Another critical tool for linking stormwater with land use is to consider land use policies in a watershed context. Each watershed is unique and has its own challenges, including:

- Important local resources, such as drinking water supplies, recreational uses, and sensitive features, such as wetlands, cold-water fisheries, and coastal bays
- Waterbodies listed as "impaired" on state Total Maximum Daily Load (TMDL) lists
- Streams and waterbodies that are currently healthy; future actions should ensure that they stay that way.
- Streams and waterbodies that are currently degraded, characterized by channel erosion and/or flooding, and/or have existing water quality problems; future actions should aim to restore watershed functions where feasible
- Watersheds that lie completely within a single jurisdiction versus those that cross one or more jurisdictional boundaries

There is no one-size-fits-all approach for integrating stormwater, land use, and watersheds. **Table 3.6** outlines various regulatory, site design, and policy strategies that can help with this integration.

Tables 3.7 and **3.8** synthesize the strategies presented in **Table 3.6** into a management framework and present a menu of options to consider. These tables list recommended strategies based on both watershed (**Table 3.7**) and land use (**Table 3.8**) characteristics. The tables also list other approaches that should be scrutinized because they might run counter to overall stormwater and land use goals.

Table 3.6. Regulatory and Site Design/Policy Strategies to Integrate Stormwater, Land Use, and Watersheds

Regulatory Tools
Overlay zoning. Overlay zoning is a technique to "overlay" more protective standards over land with existing zoning. This procedure can be helpful to stormwater managers who need special protection in a discrete area within the watershed. Examples are drinking water supply watersheds, wellhead protection areas, areas subject to flooding, and watersheds for critical resources, such as wetlands and special recreational areas. The overlay zone typically designates allowable land uses and performance standards (see below).
Special use permits. In zoning codes, there are often two lists—allowable uses and uses allowed by special use permit. Stormwater managers might want to explore the use of special use permits to apply BMPs for certain uses (e.g., stormwater hotspots, direct discharges to wetlands).
Performance standards. Performance standards are usually associated with particular land use categories, and they can also be tied to special use permits, overlay zoning, and/or rezoning applications. Examples of performance standards are minimizing clearing and grading, minimizing creation of new impervious surfaces, tree preservation or canopy targets, protection of riparian buffers, and septic system location and design.
Special stormwater criteria. Special stormwater criteria would likely reside in the stormwater ordinance and/or design manual. These are criteria that are specifically tailored to discharges to sensitive receiving waters. Examples would be temperature control for trout streams, more aggressive nutrient management for drinking water supplies and wetlands, groundwater protection criteria for wellhead protection areas, special detention criteria for flood-prone areas, and pollution prevention measures for stormwater hotspots. (See **Chapter 4** for more detail on special stormwater criteria.)
Site Design and Policy Tools
Compact development. Compact development seeks to meet a certain level of development intensity on a small footprint. Communities might be seeking this type of design to support walkability, transit station access, reduced infrastructure costs, or for water resource protection. Compact designs can be used in any development setting from ultra-urban retrofits to rural village centers.

Table 3.6. Regulatory and Site Design/Policy Strategies to Integrate Stormwater, Land Use, and Watersheds *(continued)*

Site Design and Policy Tools
Street design. Many state departments of transportation are issuing "context-sensitive" alternatives for street design. These designs include narrow streets and consider multiple transportation modes. For transportation planners, the narrow streets are aimed at slower speeds and neighborhood design models. Stormwater managers thus have overlapping interests in better street design.
Utility planning. The rational and planned expansion of public water, sewer, and other utilities is critical for both land use planning and stormwater management. Utility extensions will likely encourage future growth at higher densities. Utility extensions should be planned for areas designated for infill, redevelopment, and future growth. On the other hand, utility restrictions should be considered for sensitive watersheds.
Mixed-use development. Highly separated uses (e.g., retail, schools, housing, jobs) are implicated in highly dispersed development. A high degree of automobile-supporting infrastructure, which can be over 50% of development-related imperviousness, is "built in" because walking and other modes of travel cannot be effectively supported. Bringing the uses closer together can lower the number and length of auto trips or support trip substitution. Less roadway and parking can translate into a lowered overall development footprint.
Infill. Communities are increasingly interested in targeting development to areas where the surrounding land is already developed and served by public utilities. An example is developing housing surrounding a mall or office park. This "infilling" can satisfy a high degree of development demand in an efficient manner.
Redevelopment. One of the strongest watershed strategies is reusing (and improving) vacant or underused sites that are already under impervious cover. This is not only an urban strategy, but can work for abandoned sites in rural areas as well. Programs such as downtown revitalization, Main Street programs, and brownfield redevelopment programs support these efforts.
Conservation development. Conservation development is a strategy that can work in various development contexts (e.g. urban, suburban) to coordinate and conserve open space. For stormwater, a particular emphasis may be placed on riparian buffers, forest protection, and open-space areas that capture and disperse runoff.
Purchase and transfer of development rights (PDR, TDR). PDR programs purchase development rights from landowners and are particularly targeted to areas or watersheds where rural character and natural resources should be protected. TDR programs set up development rights markets whereby some landowners (in rural or sensitive watersheds) can sell their development rights to landowners in areas where growth, infill, and redevelopment are encouraged.
Fee-in-lieu programs for stormwater. In certain areas, stormwater management goals cannot be met solely with on-site stormwater BMPs. Watershed-based approaches are needed to address issues that extend beyond the site boundary. Examples would be areas with existing flooding or drainage problems, impaired watersheds, and watersheds with streambank erosion problems. In these cases, a fee-in-lieu payment or offset fee can be collected from developers to partially offset full on-site compliance. The local stormwater program then uses the accumulated fees to conduct needed watershed repairs and improvements. (See **Chapter 4** for more information on watershed-based stormwater management approaches and criteria.)

Table 3.7. Integrated Stormwater and Land Use Strategies Based on *Watershed Characteristics*

Watershed Characteristics	Integrated Strategies to Consider[a]	Approaches That May NOT Be Appropriate
Special receiving waters: drinking water, trout streams, wetlands, etc.	• Overlay zoning and performance standards • Conservation development • Special stormwater criteria • Low-impact development • Purchase of Development Rights (PDR) • "Sending" area for Transfer of Development Rights (TDR)	• Large-lot zoning (disperses and spreads out development impacts) • Relying solely on stormwater ponds and basins • Urban road sections • Utility and transportation expansions
Existing flooding problems	• Overlay zoning and performance standards • Special stormwater criteria • Low-impact development • Street design • Fee-in-lieu program	• Relying solely on site-by-site stormwater approaches that are not coordinated at watershed scale • Wide roads, urban road sections
Impaired streams (303(d) listed) or other water quality problems	• Special stormwater criteria • Special use permits for certain uses (e.g., hotspots) • Performance standards • Low-impact development • Conservation development	• Relying solely on stormwater ponds and basins • Urban road sections

[a] See **Table 3.6** for brief descriptions of the various strategies.

Table 3.8. Integrated Stormwater and Land Use Strategies Based on *Land Use Characteristics*

Land Use Characteristics	Integrated Strategies to Consider[a]	Approaches That May NOT Be Appropriate
Urban core: incentive/ enterprise zones, redevelopment zones, town centers, brownfields	• Waivers and variances • Fee-in-lieu program for watershed projects • Compact and mixed-use development • Infill and redevelopment incentives • Low-impact development • "Receiving" area for Transfer of Development Rights (TDR)	• Impervious cover limits • Aggressive open space requirements • Large-lot zoning • Ambitious on-site infiltration requirements
Urbanizing: designated for future growth, planned utility and/ or transportation expansions	• Fee-in-lieu program for watershed projects • Compact and mixed-use development • Conservation development • Low-impact development • Street design, Green Streets • Good stream buffering • Performance standards • "Receiving" area for TDR	• Large-lot zoning • Conventional development standards that disperse the development footprint
Rural: desire to maintain rural character and working farms, special or unique natural resources	• Conservation development • Aggressive stream buffering • Performance standards • Special stormwater criteria • Low-impact development • "Sending" areas for TDR	• Use of waivers and variances • Urban road sections • Utility and transportation expansions • Conventional development standards

[a] See **Table 3.6** for brief descriptions of the various strategies.

3.9 Considering Climate Change in the Stormwater and Land Use Program

Many of the assumptions that stormwater managers use for runoff and storm system design might become outdated if climate change predictions become a reality (**Funkhouser, 2007; Oberts, 2007**). For example, such stormwater mainstays as the "design storm" will need to be scrutinized to ensure that future stormwater designs are responsive to changing climate conditions.

Integrated stormwater and land use solutions have an important role to play in this challenging task. It is safe to assume that we cannot rely solely on "hard" or technological solutions to deal with such climate change scenarios as more frequent flooding and more prolonged droughts. Solutions more rooted in land use planning will have to play a role. These will include improved floodplain management, urban stormwater forestry, and strategies to promote more efficient development layouts—to promote greater efficiency in stormwater management, water conservation, *and* energy consumption.

EPA's climate change Web site (*http://www.epa.gov/climatechange*) includes comprehensive information on the many different issues affecting climate change. EPA's National Water Program is developing a strategy on climate change that describes how best to meet clean water and safe drinking water goals in the context of a changing climate (*http://www.epa.gov/water/climatechange*).

Stormwater managers and land use planners can work together on important adaptations to climate change. Some of these adaptations will need to respond to changing hydrologic realities (hydrologic adaptations); others will have to be coordinated with broader policy initiatives to respond to climate change (policy adaptations). **Table 3.9** provides several conceptual ideas for how integrated stormwater and land use tools can help adapt to both the natural resources and policy outcomes of climate change.

3.10. Relating Stormwater and Land Use to This Guidance Manual

Certainly, there are challenges to integrating stormwater and land use planning. They include coordination across multiple departments, coordination among multiple permitted agencies and jurisdictions, and political forces that compel land use decisions away from a watershed approach. However, the value of managing the landscape by linking land use practices to water quality protection is that long-term solutions that reduce stormwater impacts throughout the region are created.

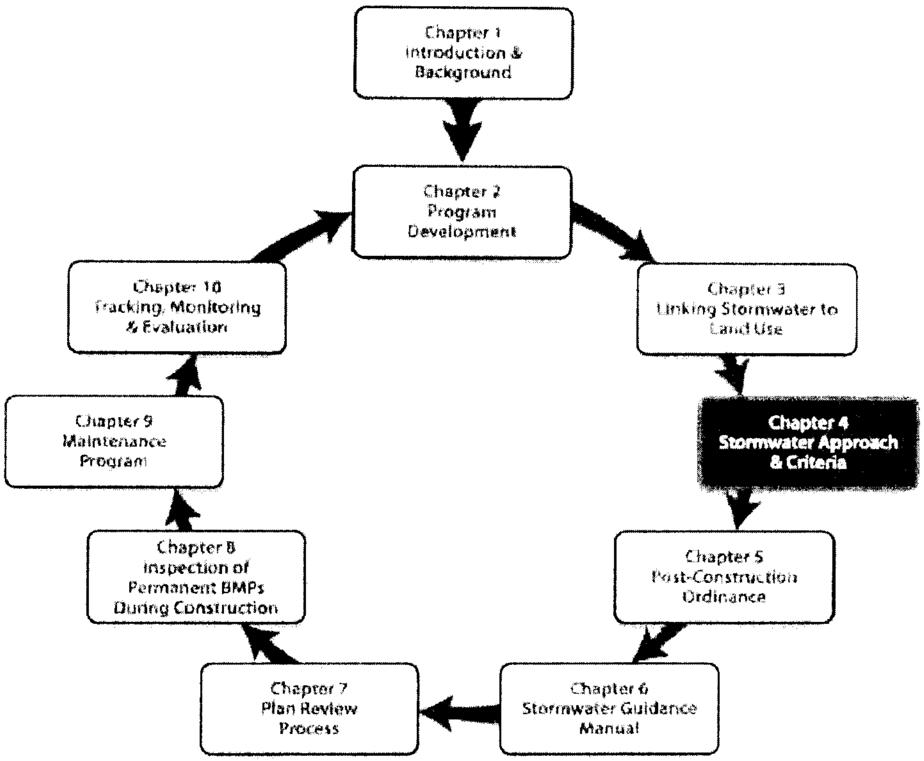
As local stormwater managers endeavor to build programs that are responsive to local conditions, state permit requirements, and existing practices, they should keep land use in mind as the "first BMP." Perhaps the simplest step is to forge stronger working relationships with land use planners and other local officials. This chapter can be a discussion starter for stormwater managers and land use planners as they begin important deliberations on how integration can and should take place at the local level.

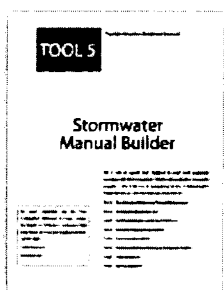
Table 3.9. Climate Change and Conceptual Land Use/Stormwater Adaptations

Hydrologic Adaptations	
More frequent flooding	• Remap floodplains based on "new" frequent and infrequent events. • Adopt stringent regulations to restrict development within floodplains. • Develop mitigation programs to remove susceptible structures from floodplains. • Conduct more frequent cleaning of storm sewer infrastructure in urban areas to maintain hydraulic capacity. • Ensure that all new development has overland relief in case of system failure. • Model storm sewer infrastructure using new climate scenarios and coordinate with emergency response plans.
More prolonged droughts	• Extend rainwater harvesting beyond individual rooftop scale to neighborhood/ community scale. Use stormwater as a resource. • Develop drought-resistant planting plans for BMPs and municipal landscaping. • Promote urban forestry and forest protection to promote shade and retention of moisture. • Incorporate groundwater recharge into all BMPs where safe and feasible.
Increased temperature of runoff	• Include trees and other plantings in BMP designs. • Develop methods to reduce "straight-piping" of runoff to streams; use disconnection methods to direct runoff to buffers, planted areas, pervious parking, forested BMPs, etc. • Develop impervious limits and minimum tree canopy requirements for special temperature-sensitive receiving waters (e.g., high-value trout streams).
More combined sewer overflows	• Incorporate volume-reduction measures across landscape: individual homes, streets, businesses, etc. These can include rain gardens, rainwater harvesting, dry wells, etc. • Strategically locate and use open-space areas for runoff capture to reduce flows into system.
Policy Adaptations	
Reduce carbon emissions	• Promote compact development and reduce vehicle trips/miles. • Provide stormwater incentives for redevelopment close to urban centers and more stringent requirements for new (greenfields) development that requires more driving. • Provide stormwater credits for transit and bicycle facilities at development sites. • Consider the embodied energy of BMP materials and installation (e.g., plastic/wood components, land cleared for BMPs) as a BMP selection criterion.
Increase carbon sequestration	• Use urban forestry as a stormwater BMP. • Incorporate trees into all or most new BMPs. • Design integrated stormwater/carbon sequestration facilities; incorporate planting maintenance plans that maximize carbon uptake.
Increase clean, renewable energy sources	• Incorporate small-scale power generation into some BMP and storm sewer designs that have adequate head. • Colocate neighborhood-scale stormwater BMPs with solar, wind, and other renewable-energy facilities.

Chapter 4

Developing a Stormwater Management Approach and Criteria





Companion Tools for Chapter 4
Download Post-Construction Tools at:
www.cwp.org/postconstruction

What's In This Chapter

- A recommended stormwater management approach
- Developing stormwater management criteria
  - Natural resources inventory
  - Runoff reduction
  - Water quality
  - Channel protection
  - Flood control
  - Redevelopment
- Developing a rainfall frequency spectrum
- Special stormwater criteria for sensitive receiving waters
- A watershed-based stormwater approach

4.1. Clarifying the Stormwater Management Approach

Chapter 2 described some fundamental steps to plan a post-construction stormwater program, and **Chapter 3** described a holistic approach for integrating stormwater with land use planning.

The next steps in program development are to put all the pieces in place to have an operational program. These include:

- Adopt or amend a stormwater ordinance.
- Develop, amend, or reference a stormwater guidance manual.
- Create a stormwater plan review process.
- Inspect permanent stormwater BMPs during initial installation and construction.
- Develop a maintenance program.
- Track, evaluate, and report on the program.

Before jumping into these tasks, it is important to clarify the overall stormwater management approach that the program will take. Stormwater management has seen many innovations in recent years. Each community should evaluate various approaches and figure out the best way to move the program forward and protect receiving waters.

This chapter outlines some basic techniques to:

- Select a stormwater management approach that will guide the program (**Section 4.2**)
- Develop stormwater management criteria to be used in ordinances and design guidance (**Sections 4.3** and **4.7**)
- Use rainfall data to link stormwater criteria to particular rainfall events (**Section 4.4**)
- Add criteria for special receiving waters (**Sections 4.5** and **4.7**)
- Consider incorporating a watershed-based approach for stormwater (**Section 4.6**)

Table 4.1 outlines some critical decisions that stormwater managers should explore to develop a local stormwater approach.

4.2. A Recommended Stormwater Management Approach

Most stormwater programs rely heavily on conventional end-of-pipe treatment of stormwater. Although these BMPs are a critical component of stormwater management, there is a broader range of options to consider. Many opportunities are missed by simply collecting and treating runoff ***after*** it has already been generated. In fact, there are many techniques to reduce stormwater impacts at the front end through site design and source control methods.

In this respect, there is a recommended hierarchy of stormwater treatment methods:

- **First, reduce runoff through design**: Use site planning and design techniques to reduce impervious cover, disturbed soils, and stormwater impacts. Use techniques such as conservation design, protecting critical open space and natural drainage features, and disconnecting a site's impervious cover to reduce the generation of stormwater runoff. At a broader community and watershed scale, this might also mean encouraging infill and development within targeted zones while preserving open spaces and functional landscapes beyond those areas (see **Table 4.2**).
- **Second, reduce pollutants carried by runoff**: Use source control and pollution prevention practices to reduce the exposure of pollutants to rainfall and runoff. Examples include keeping impervious surfaces clean, educating homeowners on proper yard waste and fertilization methods, handling and storing chemicals properly, and collecting and recycling hazardous chemicals (see **Table 4.3**).
- **Third, capture and treat runoff**: Design stormwater BMPs to collect and treat the stormwater that is generated after applying the site design and source control methods described above. Some stormwater collection and treatment can be in small-scale, distributed practices close to the source of runoff. Examples include rain gardens, filter strips, and pervious parking. Site designers should attempt to blend this approach with more conventional practices—such as ponds, stormwater wetlands, and filters—to come up with the most effective BMP design (see **Table 4.4**).

Table 4.1. Critical Decisions to Identify a Stormwater Management Approach

Land Use	What is the best way to integrate stormwater with land use? **Chapter 3** provides a detailed discussion on this important link.
Site Design	To what extent should the program promote and give credit for good site design practices, such as: • Open space conservation • Reduction of impervious surfaces and site disturbance • Riparian, wetland, and waterway buffers • Disconnection of impervious surfaces • Site reforestation • Desirable infill and redevelopment Although many stormwater programs would like to see these types of practices, fewer provide the programmatic and regulatory incentives to make it happen.
Source Controls and Pollution Prevention	While the conventional approach to stormwater management is to collect and treat runoff at some point downstream from the source, a more comprehensive approach is to reduce or eliminate the exposure of pollutants to runoff in the first place. Examples of source control and pollution prevention practices include: • Street sweeping • Pet waste education programs • Household hazardous waste collection • Spill containment and response A local program must decide how to incorporate these practices.
Conventional Stormwater BMPs	Some stormwater BMPs, such as ponds and basins, have been around for a long time. The local program must determine how to promote a better mixture of conventional and innovative practices (see below).
Low-Impact Development and Green Infrastructure BMPs	Many innovative practices can be distributed across the site and can do a good job of reducing runoff volumes and overall stormwater impacts. However, appropriate stormwater criteria and credits must be in place in order for developers and site designers to use the innovative practices. Also, the local program must have the administrative, plan review, inspection, and maintenance capabilities to ensure that conventional and innovative practices are properly designed, installed, and maintained
Special Receiving Waters	Not all watersheds are created equal. Some watersheds might require some customized approaches to stormwater management. Examples include: • Nutrient control for lakes, water supply reservoirs, and wetlands • Pollution prevention for groundwater supply areas • Additional stormwater controls for impaired waters The community must identify special receiving waters and address these unique conditions in the stormwater criteria.
Site-by-Site or Watershed-Based	Most communities address stormwater on a site-by-site basis as development takes place. However, some programs have found that they can better address watershed impacts and promote more cost-effective BMPs with a watershed approach. Programs that want to pursue this approach should create the planning, regulatory, and financial tools to make it work.
Stormwater Management Criteria	All the decisions listed above in this table must be distilled into understandable and achievable criteria that are established in the stormwater ordinance and, ideally, discussed in detail in a stormwater guidance manual. Traditionally, most stormwater programs had criteria for flood control. However, today's programs are expected to also address water quality, downstream channel protection, and perhaps runoff reduction, groundwater recharge, and natural resources protection.

Table 4.2. Hierarchy of Stormwater BMP Selection—Site Planning and Design

1. Site Planning and Design

First, reduce runoff through design:

Plan the site to reduce stormwater runoff volume and impacts through design techniques.

Preservation and/or Restoration of Undisturbed Natural Areas

Preservation of Riparian Buffers, Floodplains, and Shorelines

Preservation of Steep Slopes

Preservation of Porous and Erodible Soils

Preservation of Existing Topography

Prairie/Meadow Restoration

Site Reforestation

Soil Amendments/Soil Rejuvenation

Avoidance of Sensitive Areas

Reduced Clearing and Grading Limits

Conservation Development

Reduced Roadway Lengths and Widths

Shorter or Shared Driveways

Shared Parking

Reduced Building Footprints

Reduced Parking Lot Footprints

Reduced Setbacks and Frontages

Use of Fewer or Alternative Cul-de-Sacs

Use of Natural Drainageways

Incentives for Infill and Redevelopment Within Targeted Development Zones

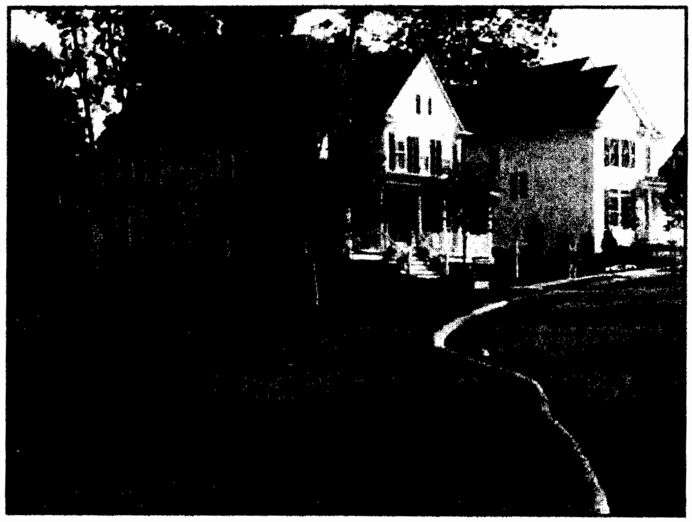


Photo courtesy of Pat Devlin

See **Tool 4: Codes and Ordinance Worksheet** for guidance on modifying local development codes to allow these practices.

Also see:

Better Site Design: A Handbook for Changing Development Rules in Your Community, Center for Watershed Protection, Inc.
www.cwp.org > Online Store > Better Site Design

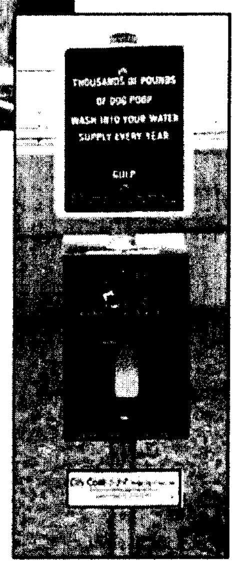
Using Smart Growth Techniques as Stormwater Best Management Practices, U.S. EPA.
http://www.epa.gov/smartgrowth/stormwater.htm

Table 4.3. Hierarchy of Stormwater BMP Selection—Source Control Practices

2. Source Control and Pollution Prevention Practices

Second, reduce pollutants carried by runoff:
Reduce exposure of pollutants to rainfall and runoff through source control and pollution prevention practices.

Residential	Nonresidential
Natural Landscaping	Covered Loading Areas
Tree Planting	Covered Fueling Areas
Yard Waste Composting	Covered Vehicle Storage Areas
Septic System Maintenance	Storm Drain Disconnection
Driveway Sweeping	Downspout Disconnection
Street Sweeping	Street Sweeping
Household Hazardous Waste Collection Programs	Covered Dumpsters
Car Fluid Collection and Recycling Programs	Covered Materials Storage Areas
Downspout Disconnection	Secondary Containment Structures
Pet Waste Pickup	Spill Response Plans
Storm Drain Marking	Signage
	Employee Training



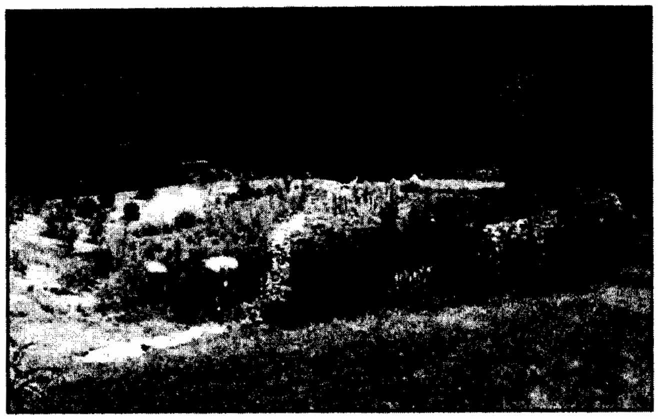
See Manual 8, *Pollution Source Control Practices, Urban Subwatershed Restoration Manual Series,* Center for Watershed Protection, Inc.
www.cwp.org > Online Store > Subwatershed Restoration Manuals

Table 4.4. Hierarchy of Stormwater BMP Selection—Stormwater Collection and Treatment

3. Stormwater Collection and Treatment

Third, capture and treat runoff:
Collect and treat stormwater runoff through small-scale distributed practices (close to the source of runoff) and other structural BMPs.

Small-Scale Distributed Practices	Other Structural BMPs
Downspout Disconnection	Infiltration Devices
Impervious Cover Disconnection	Larger Bioretention Areas
Rainwater Harvesting	Extended Detention Ponds
Rain Gardens	Wet Ponds
Small Bioretention Areas	Constructed Stormwater Wetlands
Dry Wells	Engineered Swales
French Drains	Filtering Practices
Green Rooftops	Manufactured BMPs
Porous and Pervious Pavement	
Stormwater Planters	
Vegetated Filter Strips	
Vegetated Channels/Swales	



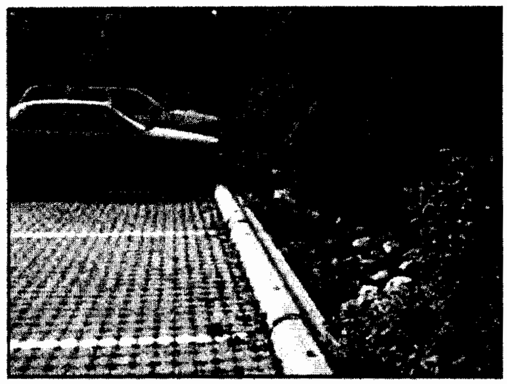


Photo courtesy of Tim Schueler

See **Tool 5: Manual Builder** for guidance on good design references.

The local program should strive to provide standards and guidelines for all three categories of stormwater treatment. **Tables 4.2** through **4.4** provide candidate BMPs and resources for each category. **Tool 5: Manual Builder** provides links to design manuals across the country that provide good examples.

4.3. Developing Stormwater Management Criteria

Stormwater management criteria are the technical core of a stormwater ordinance (**Chapter 5**) and a major focus of stormwater guidance manuals (**Chapter 6**). They establish the design objectives for BMPs, and they will influence directly the types and sizes of these practices.

The list below describes the technical stormwater criteria that are adopted by stormwater programs around the country within ordinances and design guidance. **Tool 3: Model Stormwater Ordinance** contains model language for each of these criteria. It is important to note that the Phase I and II MS4 permit program is concerned largely with criteria that help meet water quality standards (1 through 4 below). Flood control (5) is historically a more common and locally applied criterion.

1 - **Natural Resources Inventory (NRI)**: identify the site's critical natural features and drainage patterns early in the site planning process.

2 - **Recharge and/or Runoff Reduction (RR)**: maintain groundwater recharge rates and/or reduce post-development runoff volume by a set amount.

3 - **Water Quality Volume (WQV)**: capture and treat runoff from the water quality storm to remove certain target pollutants.

4 - **Channel Protection (CP)**: design the stormwater system so that conveyances and outfalls are stable and will not erode downstream channels or cause damage to downstream habitats.

5 - **Flood Control (FC)**: control peak rates to reduce downstream flooding. The criterion can have two components:

Overbank (Minor Storm) Flood Control: provide storage for storm events that might cause routine flooding to downstream property, conveyance systems, and drainage infrastructure.

Extreme (Major Storm) Flood Control: provide storage for infrequent but large storm events that might cause downstream flooding and damage and/or enlarge the boundaries of the floodplain.

6 - **Redevelopment**: provide flexibility for redevelopment sites where stormwater compliance might be more difficult and can be met through a variety of strategies. A redevelopment criterion provides flexibility in meeting criteria 1 through 5 above where a site meets the definition of redevelopment.

A unified approach is the most effective way to develop stormwater management criteria and present them within the local ordinance and/or guidance manual. The goal of a unified framework is to develop a consistent approach for designing BMPs that can:

Perform effectively: Manage the range of stormwater flows and volumes that will actually mitigate local stormwater problems; protect public health and safety; and reduce flood, water quality, and channel erosion hazards.

Perform efficiently: Manage just enough runoff volume to address the problems but not over-control them. Providing more stormwater storage is not always better, and it can greatly increase construction costs and consume valuable land.

Be simple to administer: Be understandable, relatively easy to calculate with current hydrologic models, and workable over a range of development conditions and intensities. In addition, stormwater management criteria should be clear and straightforward, and backed up by the local stormwater ordinance, to avoid needless disputes between design engineers and plan reviewers when they are applied to development sites.

Promote multipurpose, integrated stormwater design: Allow for flexible and creative design to integrate into community aesthetics, enhance property values, and serve multiple purposes (such as storm-water and recreation).

Be flexible to respond to special site conditions: Define certain site conditions or development scenarios where individual stormwater sizing criteria may be relaxed or waived when they are clearly inappropriate or infeasible.

Figure 4.1 graphically portrays a unified, or nested, approach for the six stormwater management criteria listed above.

The "nesting" of the criteria portrayed in **Figure 4.1** can best be understood by considering the overall volume of runoff generated by a site. Each of the stormwater management criteria relates to a certain volume of the overall runoff volume to be managed. For instance, runoff reduction and water quality management usually entail capturing a smaller volume of water than channel protection and flood control. However, the volume of runoff that is infiltrated, captured, and/or treated in a water quality BMP can reduce the overall volume that remains to be treated for downstream channel protection and flood control. Put another way, a site that maximizes runoff reduction through infiltration, soil absorption, and capture and reuse can reduce the size and possibly the need for larger, structural storage devices like pond and basins.

The criteria outlined in this section should be considered as candidate (or potential) criteria for a local program. The criteria should be adapted to local conditions (soils, geology, water table, etc.), the level of program sophistication, and local goals and concerns. **Table 4.5** provides some guidance for adapting the criteria to unique conditions, such as good (or poor)

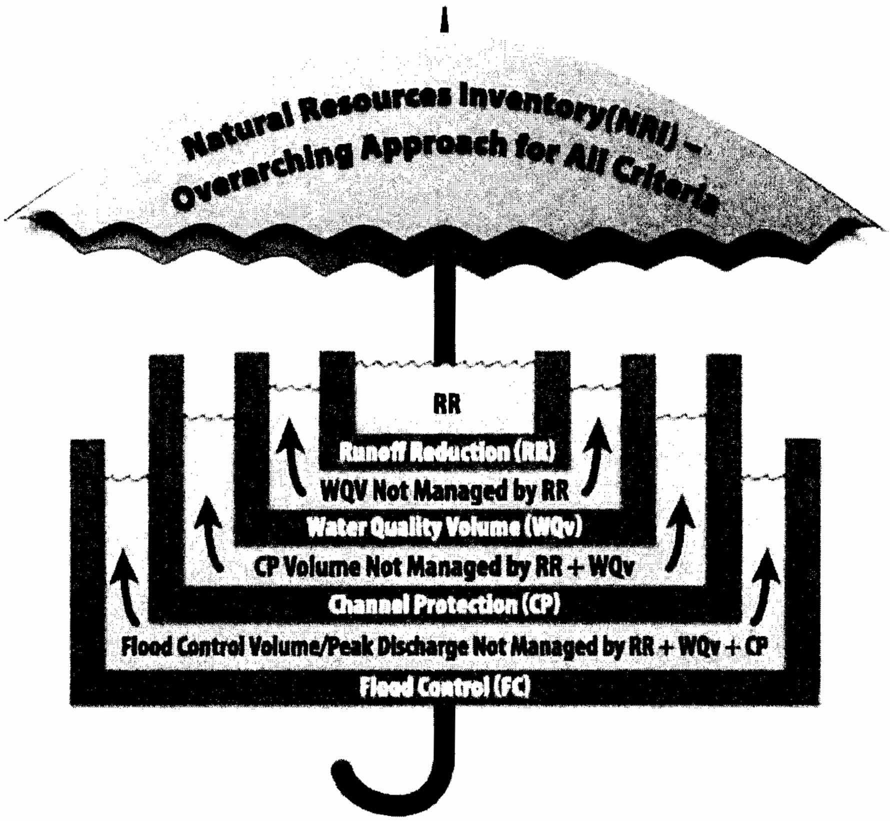


Figure 4.1. Graphic representation of the nested approach to stormwater management criteria

Table 4.5. Suggested Adaptations for Stormwater Management Criteria in Different Settings

Variable Settings for Stormwater Management	Possible/Conceptual Adaptations to Stormwater Criteria
Generally good soils for infiltration; few constraints, such as shallow bedrock	• Apply criterion 1 (natural resources) as a planning and site design tool. • Collapse criteria 2 through 4 (runoff reduction, water quality, and channel protection) into a single criterion for ***Runoff Reduction***. • Define the Runoff Reduction Volume as the 1-year, 24-hour rainfall depth, or a similar criterion adopted by the local program. • Each site should maximize runoff reduction through infiltration, canopy interception, evaporation, transpiration, and/or rainwater harvesting. • Any fraction of the Runoff Reduction Volume that cannot feasibly be eliminated from site runoff should be treated through extended detention[a] or extended filtration.[b] • Allow Runoff Reduction waivers for sites where it is not feasible. Require that the full Runoff Reduction Volume be treated in an applicable water quality BMP. • Apply criterion 5 (flood control) where it is needed to protect downstream property, conveyance systems, and infrastructure. If applicable, allow a reduction in the required volume for all or part of volume reduced through Runoff Reduction BMPs.
Arid climates	• Generally follow the guidance above for areas with good infiltration potential; rely on a balanced approach of infiltration and evaporation. Provide waivers where infiltration is not feasible or advisable. • Select BMPs based on criteria including ability to reduce sediment loads. • Apply criterion 5 (flood control), ensuring that large, damaging storm events have safe conveyance to an adequate downstream system.
Generally poor soils for infiltration; possible other constraints such as high water table or shallow bedrock	• Apply criterion 1 (natural resources) as a planning and site design tool. • Apply criterion 2 (runoff reduction) to establish a minimum, or modest, level of performance for runoff reduction, such as reducing the first 0.5 inch of runoff from the post-development condition (or an appropriate local standard). In some locations, infiltration might not be a feasible runoff reduction method. • Allow waivers for sites where runoff reduction can be proven to be infeasible (the volume should still be required to be treated for water quality; see below). • Apply criterion 3 (water quality) to a prescribed "water quality volume." This should be the 90th percentile rainfall event (see **Table 4.9**) or an applicable local standard. • Apply criteria 4 and 5 (channel protection, flood control) where they are needed to protect downstream channels, property, conveyance systems, and infrastructure. If applicable, allow a reduction in the required volume for all or part of volume reduced through runoff reduction and water quality BMPs.

Table 4.5. **Suggested Adaptations for Stormwater Management Criteria in Different Settings** *(continued)*

Variable Settings for Stormwater Management	Possible/Conceptual to Adapt Stormwater Criteria
Karst	• Combine criteria 1 (natural resources) and 2 (runoff reduction) as a planning and site design tool. Include identification of sinkholes and karst features in early site layout, with possible setbacks from these features. Promote infiltration across broad landscape areas (such as open space, swales, and soil amendment) instead of concentrating site runoff to small, engineered infiltration BMPs. Provide credits for sites that do a good job with site design. • Apply criterion 3 (water quality) to a prescribed "water quality volume." This should be the 90th percentile rainfall event (see **Table 4.9**) or an applicable local standard. Require pretreatment and/or lining for BMPs sited on karst with shallow soil cover. • Apply criteria 4 (channel protection). Develop special provisions for discharges to sinkholes and areas with no downstream surface channel to handle increased site runoff. • Apply criterion 5 (flood control) where it is needed to protect downstream property, conveyance systems, and infrastructure. If applicable, allow a reduction in the required volume for all or part of volume reduce through site design, water quality, and channel protection BMPs.
Watersheds with an extensive existing ditch system (past agricultural practices)	• Adapt criterion 1 (natural resources) to include ditch restoration and/or naturalization as a possible post-construction BMP. Practices can include adding sinuosity, restoring prior-converted wetlands, and streambank and riparian planting. • See other cases in this table for options for criteria 2 and 3. • Criteria 4 and 5 (channel protection, flood control) should consider ditch capacity As with criterion 1, ditch restoration can play a role in meeting channel protection, and possibly flood control, objectives.
Redevelopment	• Allow flexible compliance strategies for all criteria based on specific program goals and site conditions.

[a] Extended detention includes stormwater BMPs that capture runoff and release it slowly over an *extended* period, usually 12 to 24 hours. The goal is to maintain a flow rate and velocity that do not damage downstream channels.

[b] Extended filtration includes stormwater BMPs that capture runoff and delay its release until after most of the site runoff for a given storm has passed to the downstream system. Examples are bioretention and water quality swales with underdrains that delay delivery of stormwater from small sites to the downstream system by six hours or more.

soils for infiltration, karst, arid climates, and locations with extensive ditch systems. The categories in the table are fluid in that more than one category may apply to a given community, and not every possible scenario is identified. Also, the adaptations in the table are for illustrative purposes; a stormwater manager must choose the most appropriate criteria and adaptations for the local program.

Tables 4.7 through **4.12** at the end of this chapter provide more detail for each of the six stormwater management criteria. These tables are most useful for assembling language and standards for stormwater ordinances and guidance manuals (again, local adaptations are strongly encouraged). The tables provide potential standards and candidate BMPs that can be used to meet each of the criteria. Finally, the tables provide links to programs, design manuals, or existing resources that provide examples of the criteria. (**Tool 5: Manual Builder Tool** contains additional examples.)

4.4. Developing a Rainfall Frequency Spectrum

Rainfall Frequency Spectrum (RFS) curves (which are also known as "rainfall distribution plots") are useful tools to assist stormwater managers with the development of stormwater management criteria, particularly the criteria that relate to smaller storm events (runoff reduction or recharge, water quality).

The RFS helps to link the various criteria with particular rainfall events. For instance, if the local water quality criteria relate to treatment of runoff from the 90th percentile storm event, an RFS curve will help establish this particular rainfall depth. **Figure 4.2** provides guidance on creating RFS curves, and **Table 4.6** provides rainfall depth frequency statistics for cities across the United States.

4.5. Special Stormwater Criteria for Sensitive Receiving Waters

One of the unique development situations for which basic stormwater management criteria may be modified is when sensitive receiving waters must be protected. This recognizes the fact that not all stormwater discharges are created equal, and that certain watersheds require a customized approach.

There has been a trend in recent years to develop special stormwater criteria to protect sensitive water resources (**CWP, 2006**). Special stormwater design criteria have been created by state and local stormwater management programs to protect each of the following:

- Lakes and water supply reservoirs
- Cold water fisheries (trout and salmon streams)
- Groundwater
- Wetlands
- Impaired waters

Special stormwater design criteria typically make use of one or more of the following strategies:

- Enhancing stormwater BMP design features to provide a higher level of pollutant removal (e.g., sizing, internal geometry, vegetation, pretreatment, multiple treatment methods, etc.).
- Adding runoff reduction, groundwater recharge, and/or downstream analysis to provide greater protection from streambank erosion.
- Requiring the use of certain stormwater BMPs to provide additional protection for sensitive receiving waters (e.g., requiring specific stormwater BMPs at known stormwater hotspots to reduce pollutant loads).
- Instituting special design criteria for individual stormwater BMPs to enhance performance or diminish downstream impacts (e.g., for cold water fisheries, to mitigate stream warming caused by stormwater ponds).
- Establishing restrictions on where stormwater BMPs may be located at a site and where they may discharge.

Additional information on each of the special stormwater design criteria is presented in **Tables 4.13** through **4.17** at the end of this chapter.

4.6. A Watershed-Based Stormwater Approach

An emerging trend for stormwater programs is to move beyond the site-by-site design and installation of BMPs. Some programs enhance the site-by-site approach with a master stormwater plan or watershed-based plan. Such a plan integrates what is required at the site level with broader watershed projects to achieve certain watershed objectives.

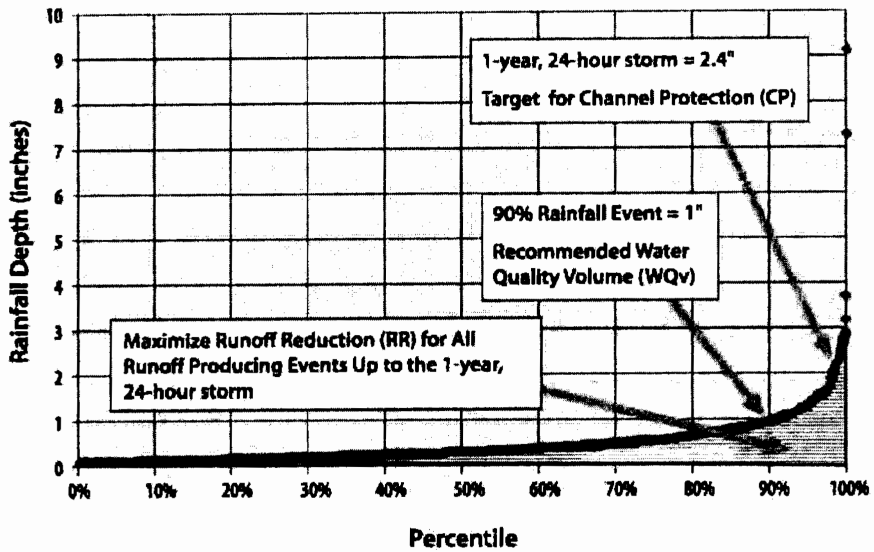
For instance, the plan might specify stream and riparian restoration projects, stormwater retrofits, impervious disconnection programs, wetland preservation, subregional BMPs, and/or watershed outreach activities. A site that is being developed within the subject watershed might contribute funds, land, or design support to a watershed project in lieu of (or, in some cases, as a supplement to) the installation of on-site BMPs. **Figure 4.3** shows several examples of watershed-based stormwater projects.

The stormwater ordinance must establish the authority to allow contributions to regional or

A Rainfall Frequency Spectrum (RFS) is a tool that stormwater managers should use to analyze and develop local stormwater management criteria and to provide the technical foundation for the criteria.

Over the course of a year, many precipitation events occur within a community. Most events are quite small, but a few can create several inches of rainfall. An RFS illustrates this variation by describing how often, on average, various precipitation events (adjusted for snowfall) occur during a normal year.

The graph below provides an example of a typical rainfall frequency spectrum and shows the percentage of rainfall events that are equal to or less than an indicated rainfall depth. As shown, the majority of storm events are relatively small, but there is a sharp upward inflection point that occurs at about 1 inch of rainfall (90% rainfall event). The 90% rainfall depth is the recommended standard for the Water Quality Volume (see **Table 4.7**).



Rainfall Frequency Spectrum for Minneapolis-St. Paul, MN (1971–2000) with several noteworthy rainfall events identified (adapted from MSSC, 2005).

Guidance on creating an RFS is provided below. If a community is large in area or has considerable variation in elevation or aspect, the RFS analysis should be conducted at multiple stations.

1. Obtain a long-term rainfall record from an adjacent weather station (daily precipitation is fine, but try to obtain at least 30 years of daily record). NOAA has several Web sites with long-term rainfall records (see *http://www.nesdis.noaa.gov*). Local airports, universities, water treatment plants, or other facilities might also maintain rainfall records.
2. Edit out small rainfall events than are 0.1 inch or less, as well as snowfall events that do not immediately melt.
3. Using a spreadsheet or simple statistical package, analyze the rainfall time series and develop a frequency distribution that can be used to determine the percentage of rainfall events less than or equal to a given numerical value (e.g., 0.2, 0.5, 1.0, 1.5 inches).
4. Construct a curve showing rainfall depth versus frequency, and create a table showing rainfall depth values for 50%, 75% 90%, 95% and 99% frequencies.
5. Use the data to define the Water Quality storm event (90th percentile annual storm rainfall depth). This is the rainfall depth that should be treated through a combination of Runoff Reduction (**Table 4.6**) and Water Quality Volume treatment (**Table 4.7**).
6. The data can also be used develop criteria for Channel Protection (**Table 4.8**). The 1-year storm (approximated in some areas by the 99% rainfall depth) is a good standard for analyzing downstream channel stability.
7. Other regional and national rainfall analysis such as TP-40 (NOAA) or USGS should be used for rainfall depths or intensity greater than 1 year in return frequency (e.g., 2-, 5-, 10-, 25-, 50-, or 100-year design storm recurrence intervals).

Figure 4.2. Creating a Rainfall Frequency Spectrum (RFS) to assist with development of stormwater management criteria

Table 4.6. Rainfall Statistics and Frequency Spectrum Data for Select U.S. Cities

City	Precipitation		Rainfall event: Depth in inches[a]				
	Annual Inches	Days[b]	50%	75%	90%[c]	95%	99%[d]
Atlanta, GA	50	77	0.5	0.9	1.6	2.1	3.4
Knoxville, TN	48	85	0.4	0.7	1.2	1.5	2.4
New York City, NY	44	74	0.4	0.7	1.2	1.7	2.7
Greensboro, NC	43	73	--	--	1.6	--	2.7
Boston, MA	43	76	0.4	0.6	1.2	1.6	2.6
Baltimore, MD	42	71	0.4	0.8	1.2	1.6	2.5
Buffalo, NY	41	88	0.3	0.5	0.8	1.1	1.8
Washington, DC	39	67	0.4	0.8	1.2	1.7	2.4
Columbus, OH	39	79	0.3	0.6	1.0	1.3	2.1
Kansas City, MO	38	63	0.4	0.7	1.1	1.7	3.2
Seattle, WA	37	90	--	--	1.3	1.6	1.7
Burlington, VT	36	79	0.3	0.5	0.8	1.1	1.7
Dallas, TX	35	32	--	--	1.1	--	3.2
Austin, TX	34	49	--	--	1.4	--	3.2
Minneapolis, MN	29	58	0.3	0.6	1.0	1.4	2.4
Coeur D'Alene, ID	26	88	0.2	0.3	0.5	0.7	1.1
Salt Lake City, UT	17	44	0.2	0.4	0.6	0.8	1.2
Denver, CO	16	37	--	--	0.7	--	--
Los Angeles, CA	13	22	--	--	1.3	--	--
Boise, ID	12	38	--	--	0.5	--	--
Phoenix, AZ	8	29	--	--	0.8	--	1.1
Las Vegas, NV	4	10	--	--	0.7	--	0.8

Notes: Dashed lines indicate no data available to compute.

[a] Excludes rainfall depths of 0.1 inch or less.

[b] Average days per year with measurable precipitation.

[c] The 90% storm is frequently used to define the water quality volume.

[d] The 99% storm is an approximation of the 1-year storm in some areas (but is not an exact replication because the statistical analysis is different). The 1-year, 24-hour storm is frequently used as a design storm for downstream channel protection. The recommended approach is to conduct an analysis of the runoff generated by the 1-year, 24-hour storm to derive channel protection criteria.

Figure 4.3. Several examples of projects that can be included in a watershed-based stormwater management program that goes beyond site-by-site compliance

watershed projects, and any general conditions for their application. Technical elements can be in the stormwater guidance manual.

A local stormwater program can incorporate a regional or watershed approach through the following means:

- *Pro rata share.* The stormwater ordinance specifies that projects within the drainage area (or "service" area) of a regional or watershed project pay a pro rata share contribution in lieu of complying with on-site requirements (at least in part). Generally, such contributions may be used only to reimburse construction costs. The mechanics of such a program (calculation of the "share" based on discharge, pollutant loads, or impervious cover) should be included in the guidance manual.
- *Fee in lieu.* The ordinance may specify that projects that meet certain criteria may (or must) pay a fee that contributes to a watershed project in lieu of some on-site requirements. The fee procedure and calculations should be included in the guidance manual, with provision for the fee to reflect realistic project costs that will probably increase over time. As opposed to the pro rata share approach, the fee may be able to be used for a wider range of project costs, including design, construction, and maintenance.
- *Capital improvement program/local implementation.* Even if new development and redevelopment projects do not contribute funds or other services to the implementation of watershed projects, the local program may still wish to adopt a watershed approach that can be implemented in parallel with required BMPs at development sites. In urbanized and urbanizing watersheds, stormwater retrofitting or stream restoration might be important strategies to address impacts from existing development. Individual projects should be identified in a watershed plan or stormwater master plan, with implementation strategies tied to the capital improvement program, grants, cost-share programs, and other funding sources.

4.7. Detailed Stormwater Management Criteria Tables

The following tables provide more detailed guidance on specific language and standards that can be adapted for stormwater management criteria. Tables **4.7** through **4.12** address the six criteria introduced in **Section 4.3**. **Tables 4.13** through **4.17** specify additional criteria for special receiving waters. The tables provide potential standards; however, it is important for local stormwater managers to assess and adapt the most appropriate standards.

The detailed tables address the following criteria:

Basic Criteria

Table 4.7 – Natural Resources Inventory (NRI)

Table 4.8 – Runoff Reduction (RR)

Table 4.9 – Water Quality Volume (WQv)

Table 4.10 – Channel Protection (CP)

Table 4.11 – Flood Control (FC)

Table 4.12 – Redevelopment

Special Receiving Waters

Table 4.13 – Lakes and Water Supply Reservoirs

Table 4.14 – Trout and Salmon Streams

Table 4.15 – Groundwater

Table 4.16 – Wetlands

Table 4.17 – Impaired (TMDL-Listed) Waters

Table 4.7. Stormwater Criteria for Ordinances and Design Guidance: Natural Resources Inventory

Criterion 1: Natural Resources Inventory (NRI) – Conduct inventory of site natural features.	
Explanation	As a first step in site planning, identify natural resources elements that should be protected in order to reduce stormwater impacts *by design*. These elements include natural drainage features, riparian buffers, wetlands, steep slopes, soils with high infiltration capacity, significant forest, prairie patches, trees, and natural communities. A local or state program can provide stormwater credits for conserving these features and/or using site design techniques to mitigate impacts on natural resource features. The effect of the credit is to reduce the required stormwater volume or treatment requirements for Runoff Reduction, Water Quality Volume, Channel Protection, and Flood Control (see Criteria 2 through 5, **Tables 4.8** through **4.11**).
Potential Standards	Identify NRI features on a concept stormwater plan. Provide credits for designs that protect or restore NRI features.
Candidate BMPs to Meet Standards	• Open space conservation, preservation, reforestation • Conservation of soils with high infiltration capacity • Riparian, wetland and waterway buffers • Conservation easements • Open space or conservation design • Green Infrastructure and Smart Growth planning at community and regional scales
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*Pennsylvania Stormwater Best Management Practices Manual*, Ch. 4, Integrating Site Design and Stormwater Management *http://www.depweb.state.pa.us/watershedmgmt/cwp/view.asp?a=1437&q=529063&watershedmgmtNav=|* *New Jersey Stormwater Best Management Practices Manual*, Ch. 2, Low-Impact Development Techniques *http://www.njstormwater.org/bmp_manual2.htm* *Minnesota Stormwater Manual*, Ch. 11, Applying Stormwater Credits to Development Sites *http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html* *Georgia Green Growth Guidelines*, Section 1, Site Fingerprinting Utilizing GIS and GPS *http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=969* *Urban Watershed Forestry Manual Series*, Parts 2 and 3, Center for Watershed Protection and USDA Forest Service *www.cwp.org* > Resources > Special Resource Management > Urban Forestry *Forest Conservation Technical Manual: Guidance for the Conservation of Maryland's Forests During Land Use Changes Under the 1991 Forest Conservation Act*, Metropolitan Washington Council of Governments (Not available online.)

Table 4.8. Stormwater Criteria for Ordinances and Design Guidance: Runoff Reduction

Criterion 2: Runoff Reduction (RR) – Reduce volume of post-development runoff.	
Explanation	Some amount of the post-development runoff should be permanently reduced through disconnecting impervious areas, maintaining sheetflow to areas of natural vegetation, infiltration practices, and/or collection and reuse of runoff. More stringent criteria should apply to sensitive receiving waters. Groundwater recharge/infiltration requirements should not apply to stormwater hotspots and contaminated soils and should be adjusted as appropriate for sites in close proximity to karst, drinking water supply wells, building foundations, fill slopes, etc Areas characterized by high water table, shallow bedrock, clay soils, contaminated soils, and other constraints should evaluate how much runoff can practically be reduced and modify the recommended standards accordingly.
Potential Standards	**Option 1: Groundwater Recharge/Infiltration** Replicate the pre-development recharge volume, based on regional average recharge rates for hydrologic soil groups. • **Residential Sites**: Post-development recharge = 90% of pre-development recharge • **Nonresidential Sites**: Post-development recharge = 60% of pre-development recharge **Option 2: Overall Runoff Reduction** • No increase in the overall runoff volume compared to the pre-development condition for all storms less than or equal to the 2-year, 24-hour storm, OR • Capture and remove from the site hydrograph the volume of water associated with the 80th percentile storm event (or a locally appropriate and achievable standard—this might be the 90th percentile storm event for areas with good infiltration potential).
Candidate BMPs to Meet Standards	• Site design that reduces and disconnects impervious cover • Soil amendments, soil rejuvenation • Rainwater collection and reuse • Pervious parking • Bioretention • Rain gardens, on-lot infiltration practices • Infiltration swales, trenches, and basins • Enhanced filter strips (with soil amendments and vegetation) • Green roofs
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*Wisconsin Post-Construction Stormwater Management* *http://dnr.wi.gov/runoff/stormwater/post-constr* *Pennsylvania Stormwater Best Management Practices Manual*, Ch. 3, Stormwater Management Principles and Control Guidelines *http://www.depweb.state.pa.us/watershedmgmt/cwp/view.asp?a=1437&q=529063&watershedmgmtNav=|* *Etowah Habitat Conservation Plan—Stormwater Management Policies* *http://www.etowahhcp.org/policies.htm* *Best Management Practices for Stormwater Quality*, American Public Works Association, Kansas City Metro Chapter *http://www.kcapwa.net/kcmetro/Specifications.asp* *Better Site Design: A Handbook for Changing Development Rules in Your Community*, Center for Watershed Protection, Inc. *www.cwp.org* > Online Store > Better Site Design

Table 4.9. Stormwater Criteria for Ordinances and Design Guidance: Water Quality Volume

Criterion 3: Water Quality Volume (WQv) – Capture and treat large percentage of annual pollutant load.	
Explanation	Post-development runoff that is not permanently removed through the application of the RR criterion (Criterion 2, **Table 4.8**) should be captured and treated in a water quality BMP. This standard applies to the *Water Quality Volume* (WQv), or the volume of runoff that contains most of the annual pollutant load. More stringent criteria should apply to sensitive receiving waters. States, regions, or localities should evaluate the pollutants of concern that should drive BMP selection and design. Nationally, the most common pollutants of concern include sediment, particulate, soluble nutrients (phosphorus and nitrogen), and bacteria. BMPs or combinations of BMPs that achieve the highest pollutant load reduction for the pollutants of concern should be selected.
Potential Standards	WQv = runoff volume generated by the 90th percentile storm event, based on regional rainfall frequencies (see **Section 4.4**). All runoff removed through the RR criterion (see Criterion #2 in **Table 4.8**) counts toward treating the WQv. The remainder must be treated in an acceptable water quality BMP.
Candidate BMPs to Meet Standards	• Filtering practices—bioretention, sand filters, manufactured filters • Water quality swales, dry swales • Linear stormwater wetlands • Stormwater ponds • Vegetated filter strips • Green roof
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*Maryland Stormwater Design Manual* *http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater* *Maine Stormwater Best Management Practices Manual, Volume II, Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development* *http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps* *California Stormwater Best Management Practice Handbooks: New Development and Redevelopment,* California Stormwater Quality Association *http://www.cabmphandbooks.com*

Table 4.10. Stormwater Criteria for Ordinances and Design Guidance: Channel Protection

Criterion 4: Channel Protection (CP) – Convey stormwater to protect downstream channels	
Explanation	The stormwater system should be designed so that increased post-development discharges that are ***not*** mitigated through application of Criteria 1 through 3 will not erode natural channels or steep slopes. This will protect in-stream habitats and reduce in-channel erosion. Conveyance systems can be designed to reduce stormwater volume, create non-erosive velocities, incorporate native vegetation, and, in some cases, restore existing channels that are degraded. This design process involves careful analysis of the downstream system, beginning with the site's position within a watershed or drainage area. First, compare the size of the on-site drainage area *at each of the site's discharge points* to the total drainage area of the receiving channel or waterway. Note that the point of analysis might not always be the property boundary of the site, but the point where the site's discharge joins a natural drainage swale, channel, stream, or waterbody. The recommended standard below presents a tiered system for CP compliance based on the site/drainage area analysis discussed above.
Potential Standards	At each discharge point from the site, if the on-site drainage area is ***less*** than 10% of the total contributing drainage area to the receiving channel or waterbody, the following Tier 1 performance standards must apply: **Tier 1 Performance Standards** • Wherever practical, maintain sheetflow to riparian buffers or vegetated filter strips. Vegetation in buffers or filter strips must be preserved or restored where existing conditions do not include dense vegetation (or adequately sized rock in arid climates). • Energy dissipaters and level spreaders must be used to spread flow at outfalls. • On-site conveyances must be designed to reduce velocity through a combination of sizing, vegetation, check dams, and filtering media (e.g., sand) in the channel bottom and sides. • If flows cannot be converted to sheetflow, they must be discharged at an elevation that will not cause erosion or require discharge across any constructed slope or natural steep slopes. • Outfall velocities must be non-erosive from the point of discharge to the receiving channel or waterbody where the discharge point is calculated. At each discharge point from the site, if the on-site drainage area is ***greater*** than 10% of the total contributing drainage area to the receiving channel or waterbody, then the Tier 1 performance standards must apply ***plus*** the following Tier 2 performance standards: **Tier 2 Performance Standards** • Sites greater than 10 acres (or a site size deemed appropriate by the local program) must perform a detailed downstream (hydrologic and hydraulic) analysis based on post-development discharges. The downstream analysis must extend to the point where post-development discharges have no significant impact (and do not create erosive conditions) on receiving channels, waterbodies, or storm sewer systems • If the downstream analysis confirms that post-development discharges will have an impact on receiving channels, waterbodies, or storm sewer systems, then the site must incorporate some or all of the following to mitigate downstream impacts: (1) Site design techniques that decrease runoff volumes and peak flows. (2) Downstream stream restoration or channel stabilization techniques, as permitted through local, state, and federal agencies. (3) 24-hour detention of the volume from post-development 1-year, 24-hour storm (the volume is stored and gradually released over a 24-hour period). Runoff volumes controlled through the application of RR and WQv measures (Criteria 2 and 3, **Tables 4.8** and **4.9**) may be given credit

Table 4.10. Stormwater Criteria for Ordinances and Design Guidance: Channel Protection *(continued)*

Variable Settings for Stormwater Management	Possible/Conceptual to Adapt Stormwater Criteria
Potential Standards (continued)	(toward meeting storage requirements. Discharges to cold water fisheries should be limited to 12-hour detention. • Sites less than 10 acres (or a site size deemed appropriate by the local program) must use a combination of the mitigation techniques listed above and verify that stormwater measures provide 12- to 24-hour detention of the volume from post-development 1-year, 24-hour storm (again, allowing credits through the application of RR and WQv measures). A detailed downstream analysis is not required unless the local program identifies existing downstream conditions that warrant such an analysis.
Candidate BMPs to Meet Standards	• Water quality swales • Grass swales • Level spreaders and energy dissipaters • Riparian and floodplain restoration • Bioretention with extra volume of soil media and/or underdrain stone • Pervious parking with underground storage • Outfall designs that use natural channel and velocity reduction features • Ponds and pond/wetland systems that provide peak flow control
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*Stormwater Management Manual for Western Washington*, Volumes I and V *http://www.ecy.wa.gov/programs/wq/stormwater/manual.html* *Bioretention Design Spreadsheet*, North Carolina State University, Stormwater Engineering Group *http://www.bae.ncsu.edu/stormwater/downloads.htm* (system to assign detention credit to bioretention) *Integrated Stormwater Management Design (iSWMD™) for Site Development*, Ch. 1, Stormwater Management System Planning and Design, North Central Texas Council of Governments *http://iswm.nctcog.org* *Henrico County, Virginia Environmental Program Manual*, Ch. 9, Minimum Design Standards, 9.01, Energy Dissipater *http://www.co.henrico.va.us/works/eesd*

Table 4.11. Stormwater Criteria for Ordinances and Design Guidance: Flood Control

Criterion 5: Flood Control (FC) – Provide peak rate control for larger storms.	
Explanation	Peak rates should be controlled in order to reduce downstream flooding. The standard depends on where a property is situated within a watershed and the design storms that typically cause flooding in the community. Flood control is customarily a local, regional, or state-driven criterion. The Flood Control criterion can address one or both of the following, depending on community priorities: • **Overbank Flood Protection**: Prevent nuisance flooding that damages downstream property and infrastructure. • **Extreme Flood Control**: Maintain boundaries of the pre-development 100-year floodplain, and reduce risk to life and property from infrequent but extreme storms. Waivers to the Flood Control criteria should be considered for: • Discharges to large waterbodies • Small sites (< 5 acres in size) • Some redevelopment projects • Sites subject to floodplain study that recommends alternative criteria • Sites where on-site detention will cause a downstream peak flow increase compared to pre-development levels due to coincident peaks from the site and watershed Communities should evaluate their existing flood control criteria to avoid costly over-control of peak rates that has marginal downstream benefits.
Potential Standards	**Overbank (Minor Storm) Flood Protection:** The post-development peak rate of discharge for the 10-year, 24-hour storm must be reduced to the pre-development peak rate. New structures or crossings within the floodplain must have adequate capacity for the ultimate (build-out) condition. (NOTE: Minor storm flood control events vary around the country, usually ranging from the 2-year to the 10-year event.) **Extreme (Major Storm) Flood Control:** The post-development peak rate of discharge for the 100-year, 24-hour storm must be reduced to the pre-development peak rate. (NOTE: Major storm flood control events vary around the country, usually ranging from the 25-year to the 100-year event.)
Candidate BMPs to Meet Standards	• Ponds and pond/wetland systems that provide peak flow control • Some underground structures • As applicable, storage under parking lots or within ball fields, open space, etc. • Floodplain and riparian management and restoration, preventing structures within the 100-year floodplain
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*Georgia Stormwater Management Manual*, Volume 2 *http://www.georgiastormwater.com* Floodplain Management Association *http://www.floodplain.org*

Table 4.12. Stormwater Criteria for Ordinances and Design Guidance: Redevelopment

Criterion 6: Redevelopment – Provide flexibility to meet criteria for redevelopment conditions.	
Explanation	Redevelopment projects can present unique stormwater challenges due to existing hydrologic impacts, compacted soils, generally small size and intensive use, and other factors. Local programs should examine flexible standards for redevelopment, so that stormwater requirements do not act as a disincentive for desirable redevelopment projects. This is especially important within designated redevelopment zones, downtown revitalization zones, enterprise zones, brownfield sites, and other areas where infill and redevelopment is promoted through local policies and incentive programs. At the same time, redevelopment offers a unique opportunity to achieve incremental water quality and/or drainage improvements in previously developed areas where stormwater controls might be few or nonexistent. Redevelopment is one of the few chances to address existing impairments.
Potential Standards	Redevelopment projects must use one or a combination of the following approaches for stormwater compliance: • Reduce existing impervious cover by at least 20%. • Provide runoff reduction and water quality treatment (Criteria 2 and 3) for at least 30% of the site's existing impervious cover and any new impervious cover. • Use innovative approaches to reduce stormwater impacts across the site. Examples include green roofs and pervious parking materials. The local program can exercise flexibility with regard to sizing and design standards for sites that are attempting to place new practices into a site with existing drainage infrastructure. • Provide equivalent stormwater treatment at an off-site facility. • Address downstream channel and flooding issues through channel restoration and/or off-site remedies. • Contribute to a watershed project through a fee-in-lieu payment.
Candidate BMPs to Meet Standards	• See **Tables 4.7** through **4.11** for various stormwater criteria • Off-site mitigation may also include stream or wetland restoration, stormwater retrofits, and regional stormwater solutions
Examples from Existing Programs – See Tool 5: Manual Builder for more examples and links	*City of Philadelphia Stormwater Management Guidance Manual*, Ch. 2, Applicability and Approval *http://www.phillyriverinfo.org* *Critical Area 10% Rule Guidance Manual*, Maryland Critical Area Commission *http://www.dnr.state.md.us/criticalarea/guidancepubs* *Developments Protecting Water Quality: A Guidebook of Site Design Examples*, Santa Clara Valley Urban Runoff Pollution Prevention Program *http://scvurppp-w2k.com/Default.htm*

Table 4.13. Special Stormwater Criteria for Lakes and Water Supply Reservoirs

Urban watersheds can produce higher unit area nutrient loads from stormwater runoff compared to other watersheds (**Caraco and Brown, 2001**). Therefore, special stormwater criteria might be needed if the receiving waters in urban watersheds are sensitive to excess nutrients. Nutrient-sensitive waters include lakes, water supply reservoirs, estuaries, and coastal areas.

Several state, regional, and local stormwater programs have developed special stormwater design criteria for nutrient-sensitive waters that require development activities to create *no net increase* in pollutant loads from the pre-development condition **or** to meet site-based load limits (e.g., no more than 0.28 pound/acre/year of total phosphorus). These criteria focus on achieving this goal using site design techniques and stormwater BMPs with a proven rate of pollutant removal efficiency.

If a designer cannot meet the total removal requirement on-site, the site owner can be allowed to pay an offset fee for the difference. This fee is set as the cost of removing an equivalent amount of pollutants elsewhere in the watershed.

Several states that require stormwater pollutant load reduction to protect sensitive waters are listed below.

Maine:	To protect sensitive lakes
New York:	To protect unfiltered surface water supply
VA/MD:	To reduce nutrients delivered to Chesapeake Bay from shoreline development
Minnesota:	To protect sensitive lakes

Photo courtesy of U.S. Army Corps of Engineers

For detailed guidance, consult the following resources:

Maine Stormwater Best Management Practices Manual, Volume II, *Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development*
http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps

Minnesota Stormwater Manual, Ch. 10, Unified Stormwater Sizing Criteria (Section 9, Lakes)
http://www.pca.state.mn.us/water/stormwater

Graphic courtesy of Tim McCabe

Table 4.14. Special Stormwater Criteria for Trout and Salmon Streams

Several state and local stormwater programs have developed special stormwater design criteria to protect trout and salmon streams. Trout and salmon populations are extremely sensitive to stream habitat degradation, stream warming, sedimentation, stormwater pollution, and other impacts associated with development. In addition, some poorly designed or located stormwater BMPs can induce stream warming that can harm trout or salmon populations. Without special design criteria, these sensitive water resources might not be adequately protected from problems associated with stormwater runoff.

Some common examples of special design criteria aimed at protecting trout and salmon streams include:

- Requiring the protection and/or restoration of riparian forest buffers
- Requiring groundwater recharge and/or runoff reduction
- Requiring downstream channel protection at development sites (although extended detention times should be limited to less than 12 hours)
- Restrictions on the use of stormwater ponds and wetlands that can cause stream warming
- Preference toward the use of infiltration and bioretention practices
- Requiring that stormwater BMPs be constructed "off-line" so they are located away from the stream
- Requiring that pilot channels, outflow channels, and pools be shaded with trees and shrubs
- Requiring that stormwater BMPs be planted with trees to maximize forest canopy cover
- Requiring that stormwater BMPs be located away from the streamside forest buffer to maximize forest canopy cover and shading in riparian areas
- Requiring pretreatment of roadway runoff to reduce sediment and road salt and sand discharges to receiving streams

Individual stormwater BMP design specifications can also be modified to prevent:

Large, unshaded permanent pools or shallow wetland areas

Extended detention times that are longer than 12 hours

Extensive riprap or concrete channels

Construction of BMPs in on-line or in-stream configurations

Photo courtesy of U.S. Fish & Wildlife Service

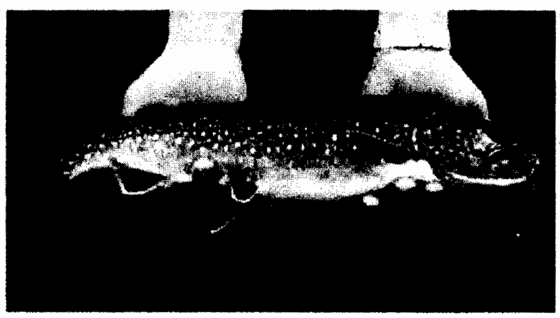


Photo courtesy of U.S. Fish & Wildlife Service

For more information, see the North Carolina State University publication *Stormwater BMPs for Trout Waters* (Jones and Hunt, 2007) *http://www.bae.ncsu.edu/stormwater/pubs.htm*

Dane County, Wisconsin, Erosion Control and Stormwater Management Manual, Ch. 3, Stormwater (Section 3.8, Thermal Control) (2007) *http://www.danewaters.com/business/stormwater.aspx*

Table 4.15. Special Stormwater Criteria for Groundwater

Groundwater is a critical water resource because many residents depend on groundwater for their drinking water and the health of many aquatic systems depends on steady recharge. For example, during periods of dry weather, groundwater sustains flows in streams and helps to maintain the hydrology of wetlands.

Because development creates impervious surfaces that prevent natural recharge, a net decrease in groundwater recharge rates can be expected in urban watersheds.

Communities that rely on groundwater as a drinking water supply have protected groundwater supplies and headwater streams by developing special criteria to require the infiltration of a certain volume of stormwater runoff and require the use of pretreatment for all stormwater BMPs. They have also required the use of low-impact development techniques, such as impervious disconnection, soil amendments, open space protection, and/or the maintenance or restoration of a certain amount of "recharge-friendly" land cover, especially forest.

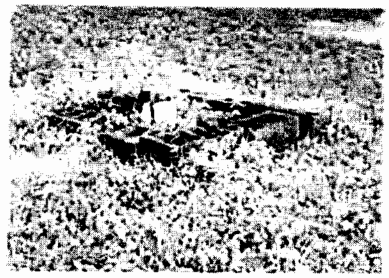
However, runoff from urban land uses and activities can degrade groundwater quality if it is directed into the soil without adequate treatment. Soluble pollutants, such as chloride, nitrate, copper, dissolved solids, and hydrocarbons can migrate into groundwater and potentially contaminate groundwater supplies. Communities should take care to ensure that groundwater supplies are both maintained with groundwater recharge and protected from contamination.

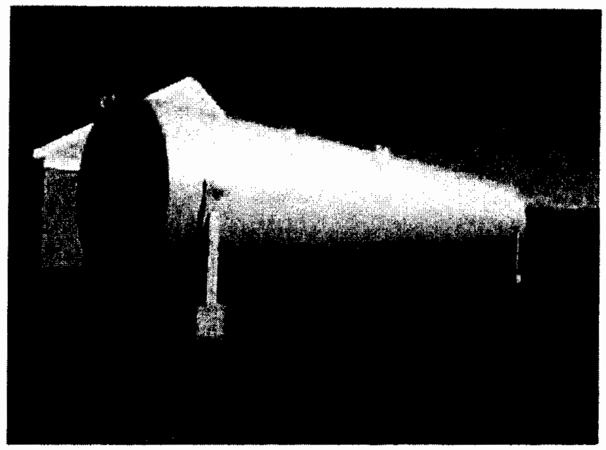
The list below contains examples of "stormwater hotspots." At these types of sites, infiltration should be discouraged and source control and pollution prevention measures adopted to minimize spills, leaks, and illicit discharges.

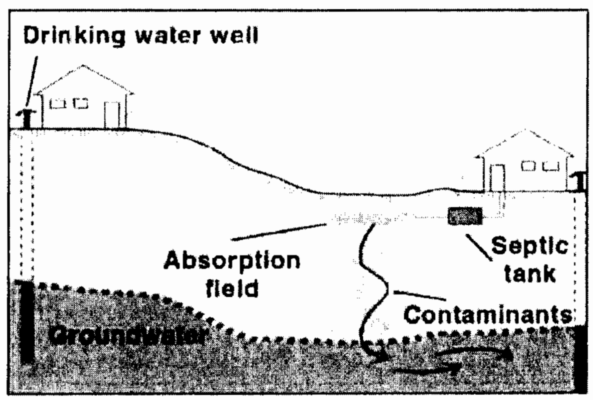
For examples of stormwater criteria and standards to protect groundwater, see **Tool 5: Manual Builder.**

Potential Stormwater Hotspots (**CWP and MDE, 2000**)

- Vehicle salvage yards and recycling facilities
- Outdoor vehicle service and maintenance facilities
- Outdoor vehicle and equipment cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Industrial sites
- Marinas (service and maintenance)
- Outdoor liquid container storage
- Some outdoor loading/unloading facilities
- Public works storage areas
- Commercial container nursery
- Large chemically managed turf areas







Graphic courtesy of Nick Evans

Table 4.16. Special Stormwater Criteria for Wetlands

Wetlands are recognized for the many important watershed functions and services they perform, and their direct disturbance is closely regulated. However, indirect impacts associated with stormwater, such as altered water level fluctuations and increased nutrient and sediment loads, are not routinely regulated or even acknowledged. Stormwater inputs can alter the hydrology, topography, and vegetative composition of wetlands (**Wright et al. 2006**). For example, increased frequency and duration of inundation can degrade native wetland plant communities or deprive them of their water supply. The deposition of sediment carried by urban stormwater can have the same effect, causing replacement of diverse species with monotypes of reed canary grass or cattails.

Cappiella et al. (2005) have developed a framework for protecting sensitive natural wetlands, including special stormwater criteria for discharges to wetlands. This information can be found at the Center for Watershed Protection's Wetlands Web Site:
www.cwp.org > Resources > Special Resource Management > Wetlands & Watersheds

Photo courtesy of U.S. Fish & Wildlife Service

Table 4.17. Special Stormwater Criteria for Impaired (TMDL-Listed) Waters

Under the Clean Water Act, water quality standards, which consist of both narrative and numeric criteria, are established to protect the physical, chemical, and biological integrity of surface waters and maintain designated uses. If water quality monitoring indicates that these water quality standards are not being met and that designated uses are not being achieved, surface waters may be added to a list of impaired waters.

When a surface water is listed, a Total Maximum Daily Load (TMDL) study and implementation plan are scheduled for development. Using water quality sampling and computer modeling, a TMDL study establishes pollutant load reductions from both point and nonpoint sources needed to meet established water quality standards.

There is increasing emphasis among state and federal permitting agencies to create stronger links between TMDLs and stormwater permits, such as MS4 permits (**USEPA, 2007; USEPA Region 5, 2007a, 2007b**). With successive rounds of MS4 permits, permitted agencies will very likely need to apply more stringent stormwater criteria in impaired watersheds and/or provide a better match between particular pollutants of concern and selected BMPs.

Strategies for Local Stormwater Managers to Address TMDLs Through Special Stormwater Criteria
Depending on the nature of the TMDL and the implementation plan, local stormwater criteria can help address TMDL requirements. The following three general approaches are discussed in order of decreasing sophistication. There are other approaches that can applied, and a local program may find that a hybrid approach is most applicable.

- Site-Based Load Limits
- Surrogate Measures for Sources of Impairment
- Presumptive BMP Performance Standards

1. Site-Based Load Limits

Some pollutants that are the basis for TMDLs are understood well enough that site-based load calculations can be done for each development and redevelopment site. These pollutants generally include sediment, phosphorus, and nitrogen (in some areas, other pollutants, such as ammonia, fecal coliform bacteria, and other pollutants can be added to the list if adequate local or regional studies have been conducted) (**MSSC, 2005**). If site-based load limits are to be used, the TMDL and local stormwater program should have the following characteristics:

- The TMDL allocates a load reduction target to urban/developed land (preferably separating out existing developed land from estimates of future developed land).
- The local program uses (or plans to use) a method, such as the Simple Method (**CWP and MDE, 2000**), that allows for the calculation of pollutant loads for a particular site development project.
- The local, regional, or state manual (or policy document) contains a method to assign pollutant removal performance values to various structural and nonstructural BMPs. Low-Impact Development (LID) credits are another positive factor so that LID practices can be incorporated.

The general process for calculating site-based load limits is as follows:

1. Based on the wasteload allocation (WLA) and load allocation (LA) in the TMDL, develop a site-based load limit for the pollutant of concern. The local program must allocate the total load reduction goal for urban/developed land to existing and future urban/developed land within the impaired watershed. The program should consider having a more flexible standard for redevelopment projects because the standard will usually be more difficult to meet for these projects.

   *Example: Site-based load limit = 0.28 pounds/acre/year for total phosphorus (**Hirschman et al. 2008**)*

   That is, if each newly developed site meets the standard of 0.28 pound/acre/year, the load reduction goal for new urban/developed land can be met.

   *In this context, other measures—such as stormwater retrofits and restoration projects—might have to be applied for existing urban/developed land (see Step 5 below and **Schueler et al. 2007**).*

2. For each development site, the applicant should calculate the post-development load for the pollutant of concern using a recognized model or method. Most use impervious cover as the main basis for calculating loads, although other land covers (e.g., managed turf) are also important contributing sources.

   Example: Post-development total phosphorus load = 0.55 pound/acre/year

Table 4.17. Special Stormwater Criteria for Impaired (TMDL-Listed) Waters *(continued)*

3. Next, the required load reduction is computed by comparing the post-development load to the site-based load limit, and an appropriate BMP is selected.

   Example: Load reduction = post-development load - site-based load limit

   0.55 - 0.28 = 0.27 pound/acre/year (load that must be removed to meet the load limit standard)

   Selected BMPs should be capable of removing the target load reduction. One way to determine this is to calculate the load leaving the BMP based on the expected effluent concentration and the effluent volume for the design storm (or on an annual basis).

4. Select a combination of structural and nonstructural BMPs that can be documented to meet the required load reduction. If the local program and/or TMDL implementation plan encourages LID, then these practices should be assigned load reduction credits (see **Section 6.10**).

5. If the entire load reduction cannot be achieved (or is impractical) on the particular site, the applicant might be eligible to implement equivalent off-site BMPs within the impaired watershed. These off-site BMP may be implemented by the applicant on developed land that is currently not served by stormwater BMPs. Alternatively, the applicant can pay an appropriate fee (fee in lieu) to the local program to implement stormwater retrofits within the impaired watershed In either case, full on-site compliance is being "traded" to implement other BMPs that can help achieve TMDL goals.

The local program would have to apply this technique to a variety of local plans to gauge achievability and feasibility across a range of development scenarios.

A good real-world example of this approach (although not specific to impaired watersheds) is Maine's *Phosphorus Control in Lake Watersheds: A Guide to Evaluating New Development* (Interim Draft, 12/10/2007). *http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps*

2. Surrogate Measures for Sources of Impairment

If site-based load limits cannot be used because of the type of impairment (e.g., aquatic life) or limited data, surrogates that have a strong link to the cause of impairment can be used. For instance, various TMDLs have used impervious cover and stormwater flow as surrogates for stormwater impacts on aquatic life, stream channel stability, and habitat (**USEPA, 2007**). In these cases, the surrogates are relatively easy to measure and track through time. The TMDL might have a goal to reduce impervious cover and/or to apply BMP treatment to a certain percentage of impervious cover within the impaired watershed.

A local stormwater program could apply the surrogate approach through a tiered implementation strategy for new development and redevelopment (see also **Section 4.2**):

- FIRST, minimize the creation of new impervious cover at the site through site design techniques. Preserve sensitive site features, such as riparian areas, wetlands, and important forest stands.
- SECOND, disconnect impervious cover by using LID and nonstructural BMPs.
- THIRD, install structural BMPs to reduce the impact of impervious cover on receiving waters.

3. Presumptive BMP Performance Standards

Perhaps the most widespread and simplest method to link TMDL goals with stormwater criteria is to presume that implementation of a certain suite of BMPs will lead to load reductions, and that monitoring and adaptive management can help adjust the appropriate template of BMPs over time (**USEPA, 2007; USEPA Region 5, 2007a**). This strategy acknowledges that data are often too limited to draw a conclusive link between particular pollutant sources and in-stream impairments. However, as more data become available and TMDL implementation strategies are refined, a more quantitative method, such as the two noted above, should be pursued.

There are a wide variety of "presumptive" BMPs that can be included in local stormwater criteria for an impaired watershed, and these should be adapted based on the pollutant(s) of concern:

- Stream/wetland/lake setbacks and buffers
- Site reforestation
- Soil enhancements
- Incentives for redevelopment

Table 4.17. Special Stormwater Criteria for Impaired (TMDL-Listed) Waters *(continued)*

- Requirements for runoff reduction (see **Table 4.8**)
- Implementation of LID
- Requirements for BMPs with filter media and/or vegetative cover
- Enhanced sizing and/or pre-treatment requirements
- Required BMPs at stormwater hotspots or particular land use categories (e.g., marinas, industrial operations)
- Contribution to stormwater retrofit projects within the watershed

The providing channel protection criterion (see **Table 4.10**) is highly recommended for receiving waters that are impaired by sediment or sediment-related pollutants. Given the importance of channel erosion in the sediment budget of urban streams, it is critical to control erosive flows from development projects.

For more information on linking TMDLs to stormwater permits, see:
Total Maximum Daily Loads with Stormwater Sources: A Summary of 17 TMDLs, EPA 841-R-07-002
http://www.epa.gov/owow/tmdl

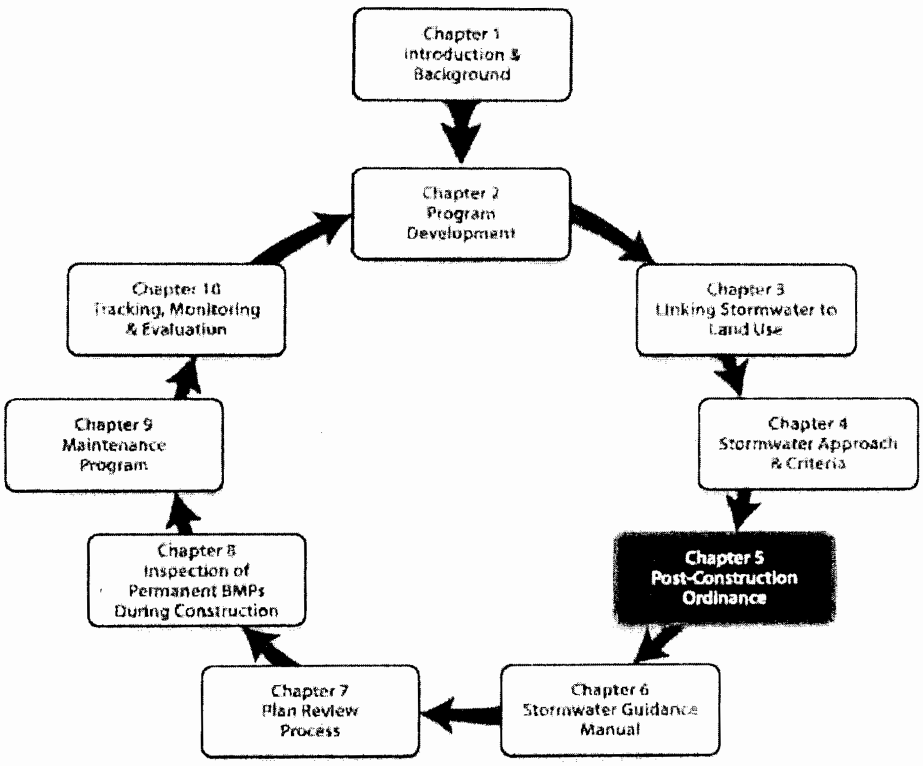
Total Maximum Daily Loads and National Pollutant Discharge Elimination System Stormwater Permits for Impaired Waterbodies: A Summary of State Practices, USEPA Region 5
http://www.epa.gov/R5water/wshednps/topic_tmdls.htm

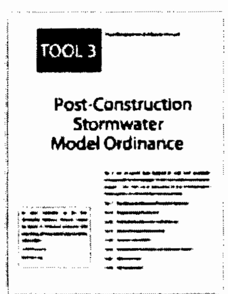
Linking TMDLs and the Implementation of Low Impact Development/Green Infrastructure Practices, USEPA Region 5

For a comprehensive primer on stormwater retrofitting in existing urban/developed land, see:
Urban Stormwater Retrofit Practices, Manual 3, Urban Subwatershed Restoration Manual Series, Center for Watershed Protection, *www.cwp.org* > Resources > Controlling Runoff & Discharges > Stormwater Management > National/Regional Guidance.

Chapter 5

Developing a Post-Construction Stormwater Ordinance





Companion Tools for Chapter 5
Download Post-Construction Tools at:
www.cwp.org/postconstruction

What's In This Chapter

- Framework for the stormwater ordinance
- Scoping out the right ordinance for the community
- Anatomy of a stormwater ordinance
  - Regulatory structure elements
  - Design elements
  - Plan review elements
  - Maintenance elements
  - Inspection & enforcement elements
  - Tips and milestones for building the stormwater ordinance
- Involving the public in ordinance adoption

5.1. Framework for the Stormwater Ordinance

General Status and Trends

The stormwater ordinance is the backbone of a local program. It provides the legal foundation for all other program elements, including design standards, development review procedures, inspections, maintenance, and enforcement. Many local programs begin to build their stormwater programs by developing and adopting a local ordinance. While this is often an early step, it can also be one of the most difficult. As a local regulation, the ordinance must have political support, and this often involves garnering public support through education and outreach efforts.

Recent research on NPDES Phase II programs revealed that about half have adopted some form of stormwater ordinance. Most of these programs were able to adopt their local ordinance in 3 years or less (**CWP, 2006**). Programs that have not yet adopted a stormwater ordinance note various reasons, including lack of funding, lack of staff, lack of political support, and lack of guidance from the state level.

Assess Existing Ordinances

Most communities have existing codes in place that address stormwater or drainage in some fashion. However, existing codes might not support or, in fact, might be inconsistent with the stormwater goals that are expected and required under NPDES MS4 permits.

Chapter 3 outlines some of the most common inconsistencies between typical local codes and a "modern" stormwater program (e.g., one that promotes good site design, reduction in impervious cover and disturbed soils, and innovative BMPs to minimize stormwater impacts). Several of these inconsistencies are shown graphically in **Figure 5.1**. These inconsistencies can be particularly acute if the local program wishes to promote low-impact development (LID) practices.

Tool 4 contains a more thorough "Codes and Ordinance Worksheet" that can be used to systematically review existing codes and identify inconsistencies with design approaches that reduce stormwater impacts. In many cases, the local program can work to eliminate these inconsistencies. Some changes to existing codes will be more difficult than others. For instance, it would be difficult to change zoning standards that are tied to statewide uniform building codes, but more straightforward to change local standards.

Using Model Ordinances

Many state and regional agencies have model stormwater ordinances. Many state-level ordinances specify the technical criteria to be adopted at the local level, although local adaptation and customization are expected. Also, many localities begin their ordinance development process by looking to good examples from neighboring communities.

Finding and using the most appropriate model is an important early step in efficiently adopting an ordinance. This step is also an early opportunity to engage the local legal staff in the development of a stormwater ordinance. **Tool 3** is a model stormwater ordinance that can serve as a good starting point (see **Figure 5.2**).

Ordinances and Design Standards

The recommended approach for most local programs is for the ordinance to reference appropriate design standards (see **Chapter 6**) but not contain these standards within the code language itself. The reasons for this are as follows:

- Design standards should be updated based on local lessons and improvements in technology. It can be a burden on the local program to amend the ordinance each time a design change is sought. Alternatively, design documents that are amended through an administrative procedure, with ample public involvement and input, are more likely to remain as living documents.
- As design standards evolve, they will contain standard diagrams, computations, and examples. It is quite burdensome to include these elements within the confines of a legal document, such as an ordinance.
- The ordinance should remain simple and readable for the widest possible audience. A separate design standards document can be written for technical audiences, such as design consultants and plan reviewers.

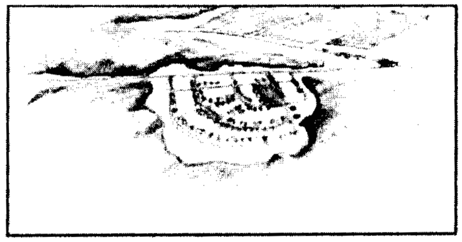
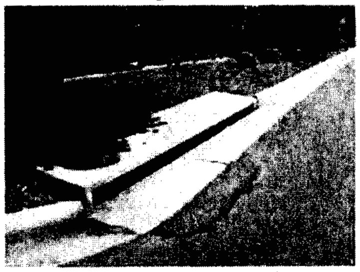
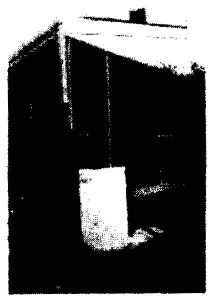
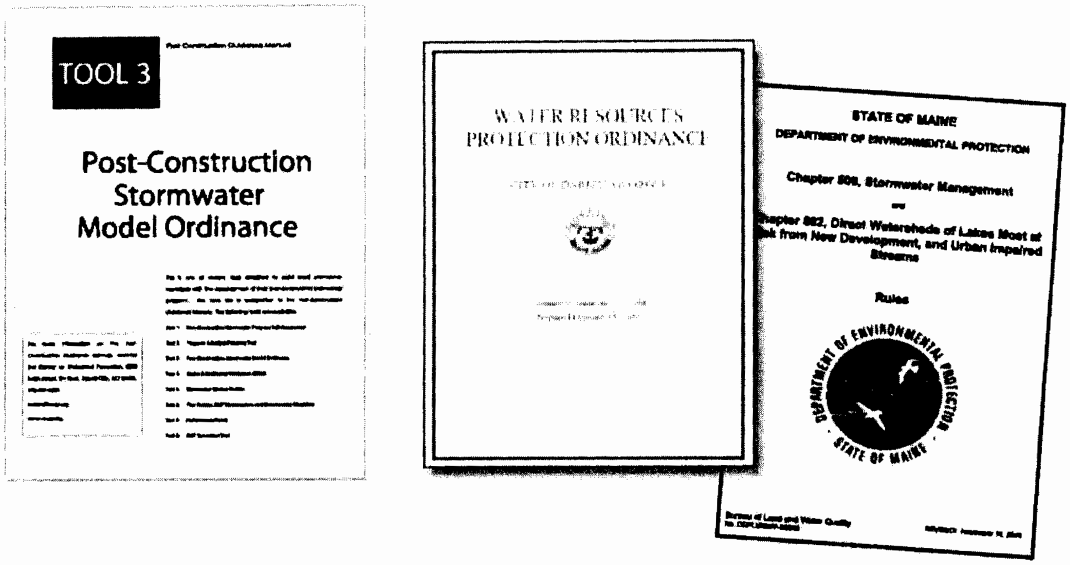
THE LOCAL CODE MAY *REQUIRE* THIS	BUT *NOT ALLOW* THIS
Subdivision with no open space  *Graphic courtesy of Rennaissance Planning Group*	**Open-space design**  *Graphic courtesy of Rennaissance Planning Group*
Curb and gutter on roads 	**Swales and grass channels** 
Parking lot islands not used for stormwater 	**Parking lot bioretention areas**  *Photo courtesy of Sanitation District #1 of Northern Kentucky*
Stormwater BMPs address only flood control 	**Stormwater BMPs address water quality and resource protection** 
Nonstructural BMPs and LID not allowed 	**Nonstructural BMPs and LID given credit** 

Figure 5.1. Existing codes may conflict wth progressive stormwater management



Other model ordinances to protect local aquatic resources can be found at CWP's Stormwater Managers' Resource Center (SMRC): *http://www.stormwatercenter.net*

Information on state-by-state stormwater regulations can be found at the stormwater authority.org Web site: *http://www.stormwaterauthority.org*

Figure 5.2. Tool 3: Model Post-Construction Stormwater Ordinance. Other state and regional ordinances are available around the country

If this approach is taken, the ordinance must be clear that the relevant design standards are contained in the *latest version* of the design document, or within the design manual *that is updated from time-to-time*. This will ensure that, as the design standards change, the ordinance requirements will attend to the most up-to-date version.

Chapter 6 specifically addresses the topic of developing a stormwater guidance manual or revising an existing state or regional manual to meet local needs.

5.2. Getting Started: Scoping Out the Right Ordinance for the Community

There are many decisions to make when crafting an ordinance. Many of these will be highlighted and clarified during program planning and goal setting. However, it is quite another challenge to translate general goals and intentions into legal language.

Before mounting the task of drafting the ordinance, it is important to scope out the unique circumstances in a given community. These local conditions might be based on the pace and type of development expected; natural conditions, such as soils and slopes; or institutional factors, such as the availability of a state model ordinance and/or design manual. The following scoping questions will help the stormwater manager frame the type of ordinance (or ordinance revisions) that is right for the community.

1. *Is there a state or regional model ordinance based on the state's MS4 permit requirements? Is adoption of this ordinance mandatory or voluntary?*
   If the stormwater manager chooses to (or is required to) use a model ordinance, the drafting job is simplified. However, the ordinance can still be tailored to local conditions and needs. For instance, special stormwater criteria or additional maintenance provisions might be appropriate for the local ordinance.

2. *Do existing local codes pertain to drainage and/or stormwater?*

   Existing codes will likely need to be augmented or overhauled to be consistent with the stormwater program's current goals and objectives. Refer to **Tools 1** and **4** (**Stormwater Program Assessment** and **Codes and Ordinance Worksheet**) for guidance on evaluating existing codes.

3. *Should the stormwater program be integrated with erosion and sediment control for construction sites and/or illicit discharge detection and elimination?*

   Some level of integration is important. Logical avenues for integration include a joint ordinance, a combined development review process, and an integrated inspection/enforcement program. Design manuals for erosion and sediment control and post-construction stormwater might be separate in some jurisdictions to avoid confusion and to keep the size of the manuals manageable.

4. *What are the permit commitments with regard to adopting an ordinance?*

   The Phase II regulations state that stormwater requirements must be implemented "by ordinance or other regulatory means." The permit may entail a specific action and schedule (e.g., adopt stormwater ordinance by Year 3 of the permit).

5. *What are the environmentally significant or sensitive resources in the community: drinking water reservoirs, sole source aquifers, areas subject to flooding, estuaries, wetlands, cold-water fisheries, recreational lakes and rivers, impaired waters, pristine streams, or other resources?*

   Although Phase I and II communities must comply with regulatory requirements, the best way to promote a program to the local community is to base it on local resources. One way to enhance the ordinance is to include special stormwater criteria (or watershed-based criteria) for locally important resources (see **Chapter 4** for more detail).

5.3. The Anatomy of a Stormwater Ordinance

Table 5.1 outlines the basic elements of a stormwater ordinance, arranged into five categories. Subsequent sections of this chapter describe each element in more detail. **Tool 3: Model Stormwater Ordinance** provides a template for a comprehensive stormwater ordinance.

Table 5.1. Basic Elements of a Stormwater Ordinance

Category 1: Regulatory Structure Elements
The ordinance can be seen as the engine for a stormwater program. All other program elements must tie back to adequate or enabling language in the stormwater ordinance. Basic regulatory elements include: • Legal authority and purposes • Definitions • Applicability for stormwater requirements • Exemptions • Waivers
Category 2: Design Elements
The ordinance's design elements influence the type, size, and design of various BMPs that can be used to comply with the ordinance, including: • Stormwater management criteria • Regional stormwater and watershed approaches
Category 3: Development Review Elements
The development or plan review process is the chief compliance tool for a stormwater program. The ordinance establishes: • Plan submission and review requirements • Requirement for a performance bond at plan approval
Category 4: Maintenance Elements
The ordinance must help lay the groundwork for long-term maintenance. Important ordinance linkages to maintenance include: • Easements for stormwater treatment and access to BMPs • Maintenance agreements to assign long-term responsibility, as well as operation and maintenance plans • Maintenance inspection and reporting requirements
Category 5: Inspection and Enforcement Elements
Enforcement tools provided in the ordinance are paramount for a successful program. Important enforcement considerations include: • Inspections for permanent BMPs • Penalties and remedies for noncompliance

Category 1: Regulatory Structure Elements

An effective ordinance must include regulatory elements to establish basic regulatory parameters as described below.

Legal Authority and Purposes

This section establishes the legal authority for a locality to manage stormwater, and it is often tied to state enabling legislation or general police powers of the jurisdiction. The purposes section establishes the goals of the ordinance, which should be tied to overall program goals. In general, these sections will be specific to the locality and based on state or federal regulations as well as local goals.

Several examples of items that might be covered in the purposes section are listed in **Table 5.2.**

Table 5.2. Purposes Section of a Stormwater Ordinance

- Reduce flooding from land development to protect stream channels, property, and public safety.
- Minimize increases in water pollution caused by stormwater runoff from land development.
- Protect the ecological integrity and quality of stream networks, surface water, and groundwater.
- Ensure that the types, locations, and function of stormwater management measures are consistent with the overall growth management goals of the community.
- Ensure that all stormwater management measures are properly maintained.

Definitions

This section provides commonly understood and legally binding definitions. These terms should be defined consistently across other related guidance and regulatory documents.

Applicability for Stormwater Requirements

The applicability provisions dictate how many sites will be captured in the regulatory process versus those that are exempt. A local program with existing staff resources, budget, and community interest will likely choose a finer mesh size (to catch more sites) than one without such assets. Applicability is an important consideration because it determines how many sites will be subject to plan review and site inspections. This decision might also dictate how many BMPs will require ongoing maintenance by a community. Other considerations are whether criteria will apply to single-family lots and all redevelopment sites.

EPA's Phase II MS4 stormwater regulations apply to new development and redevelopment projects that disturb 1 or more acres, and most state programs have adopted this same threshold. Local programs might want or need to adhere to the 1-acre-disturbed threshold. However, other programs might expand coverage by using criteria that address other stormwater concerns, such as:

- Impervious cover
- Land disturbance smaller than 1 acre
- Number of lots in a subdivision
- Watershed characteristics

Table 5.3 lists a range of stormwater applicability criteria in use around the country (**CWP, 2006**).

The applicability section should state that the threshold applies only to projects that are not part of a larger common plan of development. A phased project should consider the entire area being developed under the various phases.

Exemptions

Exempt projects are categorically excluded from stormwater requirements (as opposed to variances, which are evaluated case by case). Some exemptions are based on state code provisions; for instance, runoff from agricultural operations is exempt in some states.

Be careful: Exemptions often turn into loopholes. For example, "logging" and "farm" roads being built under an exemption have been known to turn into subdivision streets at a later time. Also, hardship should not be the basis for exemptions.

Table 5.4 lists the most common exemptions allowed in stormwater ordinances.